

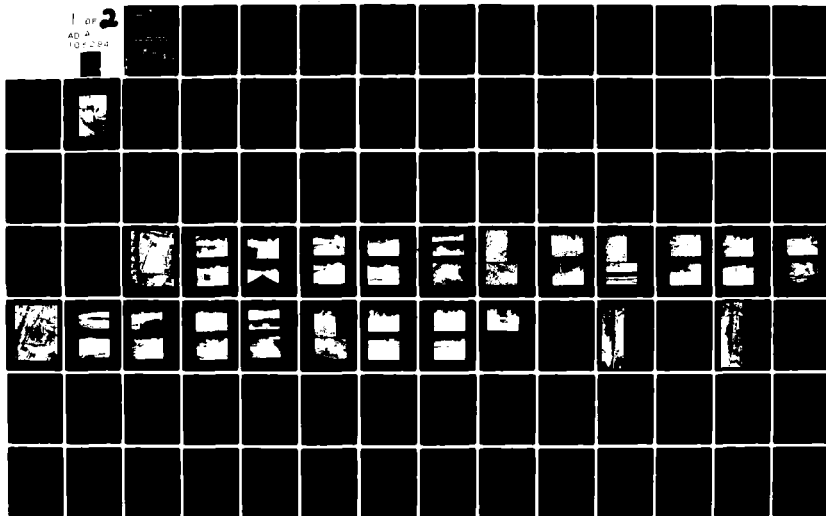
AD-A105 294

HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE
NATIONAL DAM SAFETY PROGRAM. LAKE TANGLEWOOD SOUTH DAM (MO 3122--ETC(U)
OCT 80 R S DECKER, G JAMISON, G ULMER

F/6 13/13
DACW43-81-C-0003
NL

UNCLASSIFIED

1 of 2
AD-A
105 294



LEVEL

BS (1)

MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

AD A105294

LAKE TANGLEWOOD SOUTH DAM

LAKE TANGLEWOOD NORTH DAM

CAPE GIRARDEAU COUNTY, MISSOURI

MO 31224

MO 31225

**PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**



United States Army
Corps of Engineers
... Serving the Army
... Serving the Nation

St. Louis District

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

OCTOBER, 1980

DTIC
ELECT
S OCT 8 1981 D

[Handwritten signature]

F

81 10 8 046

DTIC FILE COPY

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	AD-A105	294
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Lake Tanglewood South (MO 31224) & North (MO 31225) Cape Girardeau County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report.
7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		8. CONTRACT OR GRANT NUMBER(s) DACW43-81-C-0003
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) <i>Det - 1st Lt. ...</i>		12. REPORT DATE October 1980
		13. NUMBER OF PAGES Approximately 90
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) National Dam Safety Program, Lake Tanglewood South Dam (MO 31224), Lake Tanglewood North Dam (MO 31225), Mississippi - Kaskaskia - St. Louis Basin, Cape Girardeau County, Missouri. Phase		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

SECRET

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

INSTRUCTIONS FOR PREPARATION OF REPORT DOCUMENTATION PAGE

RESPONSIBILITY. The controlling DoD office will be responsible for completion of the Report Documentation Page, DD Form 1473, in all technical reports prepared by or for DoD organizations.

CLASSIFICATION. Since this Report Documentation Page, DD Form 1473, is used in preparing announcements, bibliographies, and data banks, it should be unclassified if possible. If a classification is required, identify the classified items on the page by the appropriate symbol.

COMPLETION GUIDE

General. Make Blocks 1, 4, 5, 6, 7, 11, 13, 15, and 16 agree with the corresponding information on the report cover. Leave Blocks 2 and 3 blank.

Block 1. Report Number. Enter the unique alphanumeric report number shown on the cover.

Block 2. Government Accession No. Leave Blank. This space is for use by the Defense Documentation Center.

Block 3. Recipient's Catalog Number. Leave blank. This space is for the use of the report recipient to assist in future retrieval of the document.

Block 4. Title and Subtitle. Enter the title in all capital letters exactly as it appears on the publication. Titles should be unclassified whenever possible. Write out the English equivalent for Greek letters and mathematical symbols in the title (see "Abstracting Scientific and Technical Reports of Defense-sponsored RDT/E," AD-667 000). If the report has a subtitle, this subtitle should follow the main title, be separated by a comma or semicolon if appropriate, and be initially capitalized. If a publication has a title in a foreign language, translate the title into English and follow the English translation with the title in the original language. Make every effort to simplify the title before publication.

Block 5. Type of Report and Period Covered. Indicate here whether report is interim, final, etc., and, if applicable, inclusive dates of period covered, such as the life of a contract covered in a final contractor report.

Block 6. Performing Organization Report Number. Only numbers other than the official report number shown in Block 1, such as series numbers for in-house reports or a contractor/grantee number assigned by him, will be placed in this space. If no such numbers are used, leave this space blank.

Block 7. Author(s). Include corresponding information from the report cover. Give the name(s) of the author(s) in conventional order (for example, John R. Doe or, if author prefers, J. Robert Doe). In addition, list the affiliation of an author if it differs from that of the performing organization.

Block 8. Contract or Grant Number(s). For a contractor or grantee report, enter the complete contract or grant number(s) under which the work reported was accomplished. Leave blank in in-house reports.

Block 9. Performing Organization Name and Address. For in-house reports enter the name and address, including office symbol, of performing activity. For contractor or grantee reports enter the name and address of the contractor or grantee who prepared the report and identify the appropriate corporate division, school, laboratory, etc., of the author. List city, state, and ZIP Code.

Block 10. Program Element, Project, Task Area, and Work Unit Numbers. Enter here the number code from the applicable Department of Defense form, such as the DD Form 1498, "Research and Technology Work Unit Summary" or the DD Form 1634, "Research and Development Planning Summary," which identifies the program element, project, task area, and work unit or equivalent under which the work was authorized.

Block 11. Controlling Office Name and Address. Enter the full, official name and address, including office symbol, of the controlling office. (Equates to funding/sponsoring agency. For definition see DoD Directive 5200.20, "Distribution Statements on Technical Documents.")

Block 12. Report Date. Enter here the day, month, and year or month and year as shown on the cover.

Block 13. Number of Pages. Enter the total number of pages.

Block 14. Monitoring Agency Name and Address (if different from Controlling Office). For use when the controlling or funding office does not directly administer a project, contract, or grant, but delegates the administrative responsibility to another organization.

Blocks 15 & 15a. Security Classification of the Report: Declassification/Downgrading Schedule of the Report. Enter in 15 the highest classification of the report. If appropriate, enter in 15a the declassification/downgrading schedule of the report, using the abbreviations for declassification/downgrading schedules listed in paragraph 4-207 of DoD 5200.1-R.

Block 16. Distribution Statement of the Report. Insert here the applicable distribution statement of the report from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 17. Distribution Statement (of the abstract entered in Block 20, if different from the distribution statement of the report). Insert here the applicable distribution statement of the abstract from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 18. Supplementary Notes. Enter information not included elsewhere but useful, such as: Prepared in cooperation with . . . Translation of (or by) . . . Presented at conference of . . . To be published in . . .

Block 19. Key Words. Select terms or short phrases that identify the principal subjects covered in the report, and are sufficiently specific and precise to be used as index entries for cataloging, conforming to standard terminology. The DoD "Thesaurus of Engineering and Scientific Terms" (TEST), AD-672 000, can be helpful.

Block 20. Abstract. The abstract should be a brief (not to exceed 200 words) factual summary of the most significant information contained in the report. If possible, the abstract of a classified report should be unclassified and the abstract to an unclassified report should consist of publicly-releasable information. If the report contains a significant bibliography or literature survey, mention it here. For information on preparing abstracts see "Abstracting Scientific and Technical Reports of Defense-Sponsored RDT&E," AD-667 000.

LAKE TANGLEWOOD SOUTH DAM - MO 31224
LAKE TANGLEWOOD NORTH DAM - MO 31225
CAPE GIRARDEAU COUNTY, MISSOURI

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR
GOVERNOR OF MISSOURI

OCTOBER, 1980

Accession For		
NTIS GRA&I	<input checked="" type="checkbox"/>	
DTIC TAB	<input type="checkbox"/>	
Unannounced	<input type="checkbox"/>	
Justification		
By		
Distribution/		
Availability Codes		
and/or		
Special		
A		



DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO
ATTENTION OF

SUBJECT: Lake Tanglewood South Dam Phase I Inspection Report
Lake Tanglewood North Dam Phase I Inspection Report

This report presents the results of field inspections and evaluations of Lake Tanglewood South Dam (MO 31224) and Lake Tanglewood North Dam (MO 31225).

It was prepared under the National Program of Inspection of Non-Federal Dams.

These dams have been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- a. Spillways will not pass 50 percent of the Probable Maximum Flood without overtopping the dams.
- b. Overtopping of the dams could result in failure of the dams.
- c. Dam failure significantly increases the hazard to loss of life downstream.

SIGNED

SUBMITTED BY:

Chief, Engineering Division

13 JUL 1981

Date

SIGNED

APPROVED BY:

Colonel, CE, Commanding

14 JUL 1981

Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TABLE OF CONTENTS

<u>PARAGRAPH NO.</u>	<u>TITLE</u>	<u>PAGE NO.</u>
	Assessment Summary	
	Overview Photograph	
	SECTION 1 - PROJECT INFORMATION	
1.1	General	1
1.2	Description of Project	1
1.3	Pertinent Data	4
	SECTION 2 - ENGINEERING DATA	
2.1	Design	9
2.2	Construction	9
2.3	Operation	9
2.4	Evaluation	9
	SECTION 3 - VISUAL INSPECTION	
3.1	Findings	10
3.2	Evaluation	14
	SECTION 4 - OPERATIONAL PROCEDURES	
4.1	Procedures	15
4.2	Maintenance of Dam	15
4.3	Maintenance of Operating Facilities	15
4.4	Description of Any Warning System in Effect	15
4.5	Evaluation	
	SECTION 5 - HYDRAULIC/HYDROLOGIC	
5.1	Evaluation of Features	16
	SECTION 6 - STRUCTURAL STABILITY	
6.1	Evaluation of Structural Stability	20
	SECTION 7 - ASSESSMENT/REMEDIAL MEASURES	
7.1	Dam Assessment	21
7.2	Remedial Measures	22

APPENDIX A - MAPS

Plate A-1	Vicinity Topography
Plate A-2	Location Map
Plate A-3	Seismic Zone Map

APPENDIX B - PHOTOGRAPHS

Plate B-1	Photo Index	Lake Tanglewood South Dam
Plate B-2	Photo No. 2	Overview Taken from the Right Side
	Photo No. 3	Upstream Slope Taken from the Right End
Plate B-3	Photo No. 4	Upstream Slope Taken from the Right End
	Photo No. 5	Crest of Dam Taken from Right End
Plate B-4	Photo No. 6	Spillway Crest Taken from the Downstream
		Slope on the Right Side of the Dam
	Photo No. 7	Downstream Slope Taken from the Right End
Plate B-5	Photo No. 8	Downstream Slope Taken from the Left End
	Photo No. 9	Looking Downstream at About the Pipe
		Spillway
Plate B-6	Photo No. 10	Looking Upstream Over the Pipe Spillway.
		Note Upper Dam in the Background.
	Photo No. 11	Inlet and Trash Rack for the Pipe Spillway
Plate B-7	Photo No. 12	Outlet of the Pipe Spillway and the Channel
		Looking Downstream
	Photo No. 13	Outlet of the Pipe Spillway
Plate B-8	Photo No. 14	Gully Coming In on the Right Side of the
		Outlet Pipe
	Photo No. 15	Gully Coming In on the Left Side of the
		Pipe Spillway
Plate B-9	Photo No. 16	Gully Coming In on the Left Side of the
		Pipe Spillway
	Photo No. 17	Looking Upstream Into the Emergency Spillway
		Taken from the Exit Channel
Plate B-10	Photo No. 18	Looking Downstream Into the Emergency Spillway
		on the Left End of the Dam. Taken from
		the Entrance Section of the Spillway.
	Photo No. 19	Two or Three Houses About 0.5 Miles Down-
		stream of Dam That Are in Potential
		Damage Zone
Plate B-11	Photo No. 20	Back of the 10th House Downstream of the Dam
		on the East Side of the Road
	Photo No. 21	Church and House About 0.5 Miles Downstream
		Just Before Channel Enters Into Main
		Drainageway (Juden Creek)
Plate B-12	Photo No. 22	Three Houses on the South Side of the Road
		About 0.5 Miles Downstream of Dam
	Photo No. 23	Shaley Limestone Exposed in Creek Bed of
		Juden Creek About 3/4 of Mile Downstream
		of Dam

Plate B-13	Photo Index	Lake Tanglewood North Dam
Plate B-14	Photo No. 24	Overview Taken from the Left Side
	Photo No. 25	Crest Taken from the Right End
Plate B-15	Photo No. 26	Upstream Slope Taken from Left End
	Photo No. 27	Downstream Slope Taken from the Right End
Plate B-16	Photo No. 28	Downstream Slope Taken from Left End
	Photo No. 29	Looking Downstream from Crest Near Principal Spillway. Lower Tanglewood Lake in the Background.
Plate B-17	Photo No. 30	Looking Upstream Over the Pipe Spillway
	Photo No. 31	Inlet of the Principal Spillway
Plate B-18	Photo No. 32	Outlet of Principal Spillway
	Photo No. 33	Outlet of Principal Spillway
Plate B-19	Photo No. 34	Emergency Spillway on Right End Taken from Upstream
	Photo No. 35	Looking Upstream in Emergency Spillway on Right End
Plate B-20	Photo No. 36	Looking Downstream in Emergency Spillway on Right End
	Photo No. 37	Left Abutment Looking into Reservoir
Plate B-21	Photo No. 38	Overview of Lower Lake Taken from the Crest of Upper Dam

APPENDIX C - PROJECT PLATES

Plates C-1 and C-2 - Lake Tanglewood South Dam

Plate C-1 Phase I - Plan and Centerline Profile of Dam

Plate C-2 Phase I - Maximum Cross Section at Sta. 2+14

Plate C-3, C-4 and C-5 - Lake Tanglewood North Dam

Plate C-3 Phase I - Plan and Centerline Profile of Dam

Plate C-4 Phase I - Maximum Cross Section of Dam at Station 1+40 and
Profile Along Centerline of Emergency Spillway

Plate C-5 Phase I - Spillway Cross Section 35' Downstream of Centerline
Spillway Cross Section at Centerline of Dam
Spillway Cross Section 8' Upstream of Centerline

APPENDIX D - HYDRAULIC AND HYDROLOGIC DATA

Plates D-1 and D-2

Plate D-3

Plate D-4

Plate D-5

Hydrologic Computations (Both Dams)

Principal Spillway Rating Curve (South Dam)

Emergency Spillway Rating Curve (South Dam)

Elevation-Area and Elevation-Capacity
Curves (South Dam)

Plates D-6 and D-7

Computer Input

Plates D-8 through D-10

Inflow Hydrograph to Lake Tanglewood
North Dam (MO 31225)

Plates D-11 through D-36

Routed Flows Through Lake Tanglewood
North Dam

Plates D-37 through D-39

Plates D-40 through D-55

Plates D-56 through D-77

Plate D-78

Plate D-79

Plate D-80

Plates D-81 through D-101

Inflow Hydrograph to Lake Tanglewood
South Dam

Combined Inflow Hydrograph to Lake
Tanglewood South Dam

Routed Flows Through Lake Tanglewood
South Dam

Principal Spillway Rating Curve (North Dam)

Emergency Spillway Rating Curve (North Dam)

Elevation - Area and Elevation - Capacity
Curves (North Dam)

Computer Input and Output for Ratios of the
PMF (North Dam)

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Names of Dams	Lake Tanglewood South Dam Lake Tanglewood North Dam
State Located	Missouri
County Located	Cape Girardeau County
Stream	Tributary to Juden Creek
Date of Inspection	October 28, 1980

Lake Tanglewood South Dam and Lake Tanglewood North Dam were inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderregger, Inc. The purpose of the inspections was to make an assessment of the general conditions of the dams with respect to safety, based upon available data and visual inspections, in order to determine if the dams pose hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

In accordance with the guidelines, a small size dam has a height greater than or equal to twenty-five (25) feet but less than forty (40) feet and a storage capacity greater than or equal to fifty (50) acre-feet but less than one thousand (1,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category.

Lake Tanglewood South Dam has a height of thirty-one (31) feet, a maximum storage capacity at the minimum top elevation of the dam of thirty-two (32) acre-feet, and is classified as a small size dam.

Lake Tanglewood North Dam has a height of 22 feet and a maximum storage capacity at the minimum top elevation of the dam of 20 acre-feet. This dam is small considering program requirements. It was inspected and included in the program due to its proximity and hydrologic impact on Lake Tanglewood South Dam. The hydrologic impact is discussed in Section 5, Hydraulic/Hydrologic Section.

In accordance with the guidelines and based on visual observation, Lake Tanglewood South Dam is in the high hazard potential classification. Due to Lake Tanglewood North Dams' proximity and hydrologic impact on Lake Tanglewood South Dam it is also classified as having a high hazard potential. The estimated damage zone extends approximately two miles downstream of the North Dam. Within the damage zone are Lake Tanglewood South Dam (MO 31224); six dwellings at 0.25 to 0.4 miles; a dwelling, building, and road at 0.6 miles; three dwellings at 0.7 miles; five dwellings and a road at 0.8 miles; three dwellings, a building and a road at 0.9 miles; four dwellings and a road at 1.0 mile; a dwelling, building and a road at 1.1 miles.

In consideration of the small volume of water impounded by the dams, the width of the downstream floodplain, and the criteria set forth in the recommended guidelines for small dams having high hazard potentials; 50% of the Probable Maximum Flood is the appropriate spillway design flood for each of the dams. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Our inspections and evaluations indicate the following:

The spillways of Lake Tanglewood South Dam do not meet the criteria set forth in the recommended guidelines. The spillways will pass the 100-year flood (1% probability flood - flood having a one percent chance of being exceeded in any one year) without overtopping the dam. The spillways will pass 10% of the probable maximum flood without overtopping the dam.

Lake Tanglewood South Dam is in good structural condition. Deficiencies noted, other than inadequate spillway capacity, are the lack of seepage and stability analyses as required by the guidelines for all dams having a high hazard potential; tree growth on the embankment and in the emergency spillway, rodent holes in the embankment and erosion gullies along both sides of the outlet end of the principal spillway conduit.

The spillways of Lake Tanglewood North Dam do not meet the criteria set forth in the recommended guidelines. The spillways will pass the 100-year flood (1% probability flood-a flood having a one percent chance of being exceeded in any one year) without overtopping the dam. The spillways will pass 9% of the Probable Maximum Flood without overtopping the dam.


Lake Tanglewood North Dam is in good structural condition, and the maintenance of the dam is good. The deficiencies noted, in addition to inadequate spillway capacity, are the lack of seepage and stability analyses as required by the guidelines for all dams having a high hazard potential; tree growth on the embankment and in the emergency spillway; and rodent holes in the embankment.

Design data were not available for these dams. Based on the field inspections and on the analyses made during and subsequent to the inspections, the following recommendations are made:


a. Alternatives.

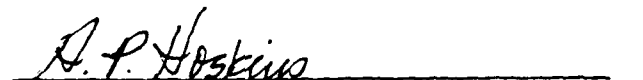
- (1) It is recommended that the height of dam and/or the spillway size be increased on both of the dams in order to pass 50% of the probable maximum flood without overtopping the dams. In either case, the spillways should be protected to prevent erosion and to prevent encroachment of spillway discharges upon the downstream section of the dams.

- (2) Tree growth should be removed from both of the embankments and spillway channels and measures taken to prevent recurrent growth. Removal of large trees should be under the guidance of an engineer experienced in the design and construction of earthen dams.
- (3) Rodent holes on both of the embankments should be repaired and measures taken to eliminate rodent activity.
- (4) Both of the embankments should be mowed periodically.
- (5) The gulleys entering the scour hole at the outlet end of the South Dam principal spillway conduit should be repaired and/or stabilized.
- (6) The wave erosion on the upstream slope of the South Dam should be monitored on a periodic basis.
- (7) The possibility of seepage occurring along the North Dam principal spillway conduit should be monitored on a periodic basis.
- (8) A program of periodic inspection and maintenance designed to cover the above items should be initiated and copies of the inspection reports made a part of this project file.


Rey S. Decker
E-3703


Gordon Jamison


Garold Ulmer
E-19246


Harold P. Hoskins, Chairman of the Board
Hoskins-Western-Sonderegger, Inc.
E-8696

MO 31225

MO 31224



PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE TANGLEWOOD SOUTH DAM - MO 31224
LAKE TANGLEWOOD NORTH DAM - MO 31225
CAPE GIRARDEAU COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that safety inspections of Lake Tanglewood South Dam and Lake Tanglewood North Dam be made.
- b. Purpose of Inspection. The purpose of the inspections was to make an assessment of the general condition of the dams with respect to safety, based upon available data and visual inspection, in order to determine if the dams pose hazards to human life or property.
- c. Evaluation Criteria. Criteria used to evaluate the dams were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams," Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams," dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dams and Appurtenances.
 - (1) Embankments. The project consists of two earth fill dams located on a tributary to Juden Creek. Lake Tanglewood South Dam (MO 31224) is located approximately 650 feet south and downstream from Lake Tanglewood North Dam (MO 31225). The dams will be identified in the text of this report as the South Dam and the North Dam.
 - (a) South Dam. The embankment consists of an earth fill about 275 feet in length and 31 feet in height. The maximum storage capacity at the minimum top elevation of the dam is 32 acre-feet. A concrete paved road crosses on the crest of the dam.

- (b) North Dam. The embankment consists of an earth fill approximately 290 feet in length and 22 feet in height with a maximum storage capacity at the minimum top of dam elevation of 20 acre-feet.
- (2) Principal Spillway. The principal spillways of the two dams are uncontrolled and are identical in construction.
 - (a) Inlet Structure. The upstream end of the principal spillway conduit for each of the dams is equipped with a hooded inlet having an anti-vortex plate mounted on top of the hood. The hooded inlets and anti-vortex plates are bituminous coated. Trash racks protect the inlet ends of both spillways. Views of the South Dam inlet are shown in photos 10 and 11. The North Dam inlet is shown in photos 30 and 31.
 - (b) Conduit. The principal spillway conduit for each of the dams consists of 24-inch diameter bituminous coated corrugated metal pipe. It is not known whether seepage collars are located on either of the conduits. The South Dam principal spillway is 138 feet in length and is located at station 2+14 as shown on Plate C-1. Its profile is shown on Plate C-2. Photos 12 and 13 show views of the outlet end of the conduit. The North Dam principal spillway is 102 feet in length and is located at station 1+43 as shown on Plate C-3. Its profile is shown on Plate C-4. Photos 32 and 33 show views of the outlet end of this conduit.
 - (c) Stilling Basin. There is no structural stilling basin for the principal spillway of either of the dams.
- (3) Emergency Spillway.
 - (a) South Dam. The emergency spillway is an uncontrolled, vegetated earth spillway located in the left abutment and a low area of the dam embankment. The control section of the spillway is the concrete surfaced road that crosses the dam which acts as a broad crested weir. The control section has a parabolic cross section with a top width of about 100 feet. The concrete road width is 20 feet. The spillway discharges onto the left abutment trough and downstream slope of the embankment on the left side. Details of the spillway are shown on Plate C-1. Photos 17 and 18 show views of the emergency spillway.
 - (b) North Dam. The emergency spillway is an uncontrolled, vegetated earth channel cut through the right abutment. The spillway control section has a 5-foot bottom width with side slopes of 1V on 5H. The entrance channel is about 28 feet in length on a negative grade of 11% to the control section at the centerline of the dam. From the centerline of the dam, the grade breaks downward to a positive grade of 8%. The plan view, profile, and cross sections are shown on Plates C-3, C-4, and C-5. Photos 34, 35 and 36 show views of the emergency spillway.

- (4) Low-Level Outlet. There is no low-level outlet structure for either of these dams.
- (5) Pertinent physical data are given in paragraph 1.3.
- b. Location. The dams are located in the east central portion of Cape Girardeau County, Missouri, just north of the City of Cape Girardeau, as shown on Plate A-2. The dams are shown on Plate A-1 in the SW $\frac{1}{4}$ of Section 17, T31N, R14E.
- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. A small size dam has a height greater than or equal to 25 feet, but less than 40 feet and a storage capacity greater than or equal to 50 acre-feet but less than 1,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category.
- (1) South Dam. Lake Tanglewood South Dam has a height of 31 feet and a maximum storage capacity at the minimum top elevation of the dam of 32 acre-feet. This dam is classified as a small size dam.
- (2) North Dam. Lake Tanglewood North Dam has a height of 22 feet and a maximum storage capacity at the minimum top elevation of the dam of 20 acre-feet. This dam is small considering program requirements. It was inspected and included in the program due to its proximity and hydrologic impact on Lake Tanglewood South Dam. The hydrologic impact is discussed in Section 5, Hydraulic/Hydrologic Section.
- d. Hazard Classification. Guidelines for determining hazard classification of dams and impoundments are presented in the guidelines as referenced in paragraph 1.1c above.

Aerial photographs of the downstream damage zone of this dam were taken in October, 1980. These photographs were used as reference in the field observations of the damage zone which were made during the inspection. Based on the field observations and on the referenced guidelines, Lake Tanglewood South Dam is in the High Hazard Potential Classification. Due to Lake Tanglewood North Dam's proximity and hydrologic impact on the South Dam it is also classified as having a High Hazard Potential. The estimated damage zone extends approximately two miles downstream of the North Dam. Within the damage zone are Lake Tanglewood South Dam (MO 31224); six dwellings at 0.25 to 0.4 miles; a dwelling, building, and road at 0.6 miles; three dwellings at 0.7 miles; five dwellings and a road at 0.8 miles; three dwellings, a building and a road at 0.9 miles; four dwellings and a road at 1.0 mile; a dwelling, building and a road at 1.1 miles.

- e. Ownership. The dams are owned by the Tanglewood Homeowners' Association, c/o Mrs. Thomas Millburg, Secretary, Cape Girardeau, Missouri 63701.
- f. Purpose of Dams. The dams were constructed as a part of a housing development. The South Dam forms a recreational lake covering 2+ acres and impounding 16+ acre-feet of water at normal pool elevation. The North Dam also forms a recreational lake covering 2+ acres. The impoundment behind the North Dam at normal pool elevation is 15+ acre-feet.
- g. Design and Construction History. No design or construction data were available. The following information was supplied by Mr. Vernon Landgraf, a Cape Girardeau realtor who developed the area. The dams were built in 1970 by a road contractor with some design assistance from the Soil Conservation Service. There were, however, no plans for the dams. The dams were deeded to the Tanglewood Homeowners' Association in 1971.
- h. Normal Operating Procedure. There are no operating facilities for these dams. The pool levels are controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillways.

1.3 PERTINENT DATA

- a. Drainage Area.
 - (1) South Dam. 59 acres (0.09 square miles).
 - (2) North Dam. 45 acres (0.07 square miles).
- b. Discharge at Damsites.
 - (1) South Dam.
 - (a) All discharges at the damsite are through a 24-inch diameter bituminous coated corrugated metal pipe with hooded inlet and through an uncontrolled, vegetated earth spillway located on the left side of the dam with a concrete surfaced road normal to the spillway acting as a weir control.
 - (b) Estimated maximum flood at damsite - unknown.
 - (c) The principal spillway capacity varies from 0 c.f.s. at elevation 468.0 feet to 23 c.f.s. at the crest of the emergency spillway (elevation 472.2 feet) to 26 c.f.s. at the minimum top of dam (elevation 472.9 feet).
 - (d) The emergency spillway capacity varies from 0 c.f.s. at its crest (elevation 472.2 feet) to 123 c.f.s. at the minimum top of dam (elevation 472.9 feet).

(2) North Dam.

- (a) All discharges at the damsite are through a 24-inch diameter bituminous coated corrugated metal pipe with hooded inlet and through an uncontrolled, vegetated earth emergency spillway. Discharges from this dam flow directly into the adjoining Lake Tanglewood South Reservoir (MO 31224).
- (b) Estimated maximum flood at damsite -- unknown.
- (c) The principal spillway capacity varies from 0 c.f.s. at elevation 486.8 feet to 9 c.f.s. at the crest of the emergency spillway (elevation 488.1 feet) to 14 c.f.s. at the minimum top of dam (elevation 489.0 feet).
- (d) The emergency spillway capacity varies from 0 c.f.s. at its crest (elevation 488.1 feet) to 18 c.f.s. at the minimum top of dam (elevation 489.0).
- (e) Total spillway capacity at the minimum top of dam is 32 c.f.s. \pm .

c. <u>Elevations (feet above M.S.L.).</u>	<u>South Dam</u>	<u>North Dam</u>
(1) Observed pool -	465.5	485.0
(2) Normal pool -	468.0	486.8
(3) Spillway crests		
Principal -	468.0	486.8
Emergency -	472.2	488.1
(4) Maximum experienced pool -	Unknown	Unknown
(5) Top of dam (minimum) -	472.9	489.0
(6) Streambed -	442 \pm	467 \pm
(7) Maximum tailwater -	Unknown	Unknown
d. <u>Reservoir. (Length (feet) of pool).</u>		
(1) At principal spillway crest -	525 \pm	550 \pm
(2) At emergency spillway crest -	580 \pm	650 \pm
(3) At top of dam (minimum) -	600 \pm	750 \pm

e. <u>Storage (acre-feet).</u>	<u>South Dam</u>	<u>North Dam</u>
(1) Observed pool -	12±	11±
(2) Normal pool -	16±	15±
(3) Spillway crests		
Principal -	16±	15±
Emergency -	32±	18±
(4) Maximum experienced pool -	Unknown	Unknown
(5) Top of dam (minimum) -	32±	20±
f. <u>Reservoir Surface (acres).</u>		
(1) Observed pool -	1.4±	1.7±
(2) Normal pool -	2.3±	2.2±
(3) Spillway crests		
Principal -	2.3±	2.2±
Emergency -	4.0±	2.5±
(4) Maximum experienced pool -	Unknown	Unknown
(5) Top of dam (minimum) -	4.0±	2.9±
g. <u>Dam.</u>		
(1) Type -	Earth fill	Earth fill
(2) Length -	275 feet ±	290 feet ±
(3) Height -	31 feet ±	22 feet ±
(4) Top width -	36 feet (includes 20 feet of paved road)	10 feet
(5) Side slopes		
(a) Downstream -	IV on 3.1 H	IV on 3 H
(b) Upstream - (Measured on IV on 3.1 H Exposed slope)		IV on 3.8 H
(6) Zoning -	Unknown	Unknown
(7) Impervious core -	Unknown	Unknown
(8) Cutoff -	Unknown	Unknown
(9) Grout curtain -	Unknown	Unknown

g. <u>Dam.</u> (Continued)	<u>South Dam</u>	<u>North Dam</u>
(10) Wave protection -	Well vegetated	Well vegetated
(11) Drains -	Unknown	Unknown
h. <u>Diversion Channel and Regulating Tunnel.</u>	None	None
i. <u>Spillways.</u>		

(1) Principal.

(a) Type - Uncontrolled, 24-inch diameter bituminous coated corrugated metal pipe with hooded inlet, anti-vortex device and trash rack passing through each of the embankments.

(b) Crest (invert) elevation - 468.0 feet (South Dam)
- 486.8 feet (North Dam)

Outlet (invert) elevation - 442.7 feet (South Dam)
- 467.0 feet (North Dam)

(c) Length - 138 feet \pm (South Dam)
- 102 feet \pm (North Dam)

(2) Emergency.

(a) Type.

1. South Dam. Vegetated earth, uncontrolled, located in the left side of dam. Cross section is parabolic with a top width of approximately 100 feet.

2. North Dam. Uncontrolled, vegetated earth channel cut through the right abutment.

(b) Control section.

1. South Dam. Concrete surfaced road running normal to the spillway channel centerline, approximately 20 feet wide.

2. North Dam. A 5-foot bottom width with 1V on 5H side slopes located on the centerline of the dam.

(c) Crest elevation.

1. South Dam. 472.2 (minimum top of road).

2. North Dam. 488.1

(d) Upstream channel.

1. South Dam. Sparsely vegetated, many trees.
2. North Dam. Vegetated, small willows in entrance,
and on an -11% grade.

(e) Downstream channel.

1. South Dam. Vegetated, many trees, consists of
the left abutment trough and the downstream slope of the
left embankment.
2. North Dam. Vegetated, choked with brush and weeds,
and on an +8% grade.

j. Regulating Outlets. - No regulating outlets for either dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for these dams. Mr. Vernon Landgraf, a Cape Girardeau realtor who developed the area, reported that some design assistance was given by the Soil Conservation Service. The Jackson, Missouri field office of the Soil Conservation Service was contacted prior to the inspection. There were no plans or other data in the SCS files regarding these dams.

2.2 CONSTRUCTION

No construction data were available for these dams. Mr. Vernon Landgraf reported that the dams were constructed in 1970 by a road contractor. No other information was available.

2.3 OPERATION

It was reported by Mr. Landgraf that the emergency spillways of the two dams have never operated. Visual observation, however, indicated that the emergency spillway of the North Dam has had some flow through it. There was no evidence to indicate that either of the dams have been overtopped. No other information on operation was available.

2.4 EVALUATION

- a. Availability. No data were available.
- b. Adequacy. The field surveys and visual observations presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General. Visual inspections of Lake Tanglewood South Dam and Lake Tanglewood North Dam were made on October 28, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were:

Rey S. Decker - Geotechnical
Garold G. Ulmer - Hydraulics and Hydrology
Gordon Jamison - Hydraulics and Hydrology

Mrs. Thomas Millburg, Secretary of the Tanglewood Homeowners' Association, was contacted prior to the inspection but was not present during the inspection. Mr. Vernon Landgraf, a Cape Girardeau realtor who developed the area, was also contacted prior to inspection and was interviewed concerning the construction and design of the dam. Mr. Landgraf did not accompany the inspection team during the inspection.

- b. Dam.

- (1) Geology and Soils (abutment and embankment). The two embankments are situated in the uplands of the loess mantled hills west of the Mississippi Valley. Within the Ozark physiographic province, the structure is controlled by earth movement associated with the Ozark uplift and local structural activity. The major structural features are the Jackson and Cape Girardeau faults and the Brooks Dome. The Seismic Zone is 3. The bedrock underlying the loess mantle is the Bailey information.

The embankment is composed of low plastic silty clays and clayey silts derived from the Memphis-Loring soils and underlying loess. The loess mantle is 5 to 20 feet thick and covers the eroded surface of the Bailey information. Locally this formation consists of very light gray to light grayish brown cherty limestone. Residual sandy silts and clays with chert gravel fractions occur in the alluvium. The formation has a low hydraulic conductivity acting as an aquitard to the underlying units. The seepage from the impoundment is perched on the bedrock with static water levels in local wells at over 150 feet (Robertson, Fuller & Knight, 1963). No evidence of solution cavitation was observed. Catastrophic collapse from leaky impoundments in this region was not observed. Aley, Williams and Massello, 1977, do not list such collapse as a high potential in this region.

The denuded loess mantle is highly erosive. Rills and small gulleys are evident in the as yet unvegetated lots. The embankment is vegetated and shows no evidence of recent erosion. Gulleys in the alluvium up to 5 feet deep are evidence of pre-dam erosion.

Stover, Reagor and Algermissen, 1979, list the following years in which earthquakes above V on the Modified Mercalli Scale were experienced: 1895, 1909, 1919, and 1977. These epicenters are within 25 radial miles.

Groundwater seepage from the impoundment is controlled by the alluvial-colluvial materials supporting the embankment. These materials consist of slightly plastic clayey silts and silty clays, residual clays and cherty gravels on the weathered surface of the underlying bedrock and limestone fragments. The thickness of the alluvium ranges from 5 to 10 feet.

(2) Upstream Slope.

- (a) South Dam. The upstream slope is well vegetated with adapted grasses above the normal pool elevation. Wave erosion has caused a 6 to 8-inch scarp at normal pool elevation, but it did not appear to be serious. No cracks, bulges or other deformations were noted on the slope. Materials taken from hand auger samples were field identified as silty clays and clayey silts (CL-ML).

A number of small willow trees are growing along the normal reservoir level. Some rodent activity was noted at about normal pool level on the left side of the pipe spillway inlet. Photos 2, 3 and 4 show the upstream slope.

- (b) North Dam. The upstream slope is well vegetated with adapted grasses from the crest down to the normal waterline. No significant erosion was evident on the slope. A few small willows are growing on the slope toward the right end of the dam. No cracks, bulges or abnormal deformations were observed. Some rodent (probably muskrat) activity was noted at the normal water line about 50 feet from the right end of the dam (about Station 2+50). Photos 24, 25 and 26 show the upstream slope.

(3) Crest.

- (a) South Dam. The crest serves as a roadway with a 20-foot width of concrete pavement. The remainder of the crest is sparsely vegetated with grass and weeds. The crest is slightly higher (0.5 ft. \pm) in the center of the dam than at the abutments. No cracks, slumps, or abnormal deformations were noted on the crest. Photo 5 shows the crest of the dam.

- (b) North Dam. The crest is sparsely vegetated with adapted grasses. However, no significant erosion was noted. No cracks were observed. The profile at the crest shown on Plate C-3, Appendix C, indicates that the center section is 1 to 2 feet higher than the ends of the dam. (It was undoubtedly constructed this way.) A slight depression or swag in the crest was observed in the area of the principal spillway crossing. No other deformations were observed. Materials on the crest were sampled by hand auger and field classified as ML-CL. Photos 25 and 27 show the crest.

(4) Downstream Slope.

- (a) South Dam. The downstream slope is well vegetated with adapted grasses which should be mowed. No cracks, bulges, slumps, or other deformations were observed. No seepage was observed on the slope, along the toe, or in the outlet channel below the pipe spillway outlet. Some rodent activity was noted at several locations on the slope. Photos 7 and 8 show the downstream slope.
- (b) North Dam. The downstream slope is well vegetated. No tree growth or rodent activity were observed on the slope. Several trees (up to 8 or 10 inches in diameter) and brush are growing along the toe of the dam on the right end. It appears that these trees were left in place when the dam was constructed. There were no indications of seepage on the slope or along the toe of the dam. However, there was water standing in the channel at the outlet of the pipe spillway, and the reservoir level was about 3.5 feet below the inlet of the spillway. There was no flow observed in the channel downstream from this area. No cracks, bulges or other deformations were observed on the slope.

Hand auger borings made up from the toe of the slope showed dry ML soil to depths of 2.5 to 3 feet. Photos 27 and 28 show the downstream slope.

c. Appurtenant Structures.

(1) Principal Spillway.

- (a) Inlet Structure. The inlet for each of the dams consists of a hooded 24-inch diameter corrugated metal pipe with anti-vortex device and trash rack.
 - 1. South Dam. The inlet was not obstructed and appeared to be in good condition. Photos 10 and 11 show the inlet to the principal spillway.
 - 2. North Dam. The inlet appeared to be in good condition. A few very small willows were growing in and around the trash rack. Photos 30 and 31 show the inlet structure.
- (b) Conduit. The conduit for each of the dams consists of 24-inch diameter corrugated metal pipe passing through the embankment.
 - 1. South Dam. The conduit appears to be in good condition. Photos 12 and 13 show the outlet end of the conduit. Erosional gulleys from surface runoff are head cutting upstream from the stilling basin on both sides of the outlet pipe. If left uncontrolled, these gulleys could ultimately cause damage to the outlet end of the spillway pipe. Photos 14, 15 and 16 show the gulleys.

2. North Dam. The outlet of the conduit appears to be in good condition, but the coating is missing in some areas and some rusting was observed. Photos 32 and 33 show the outlet of the conduit.

(c) Stilling Basin.

1. South Dam. The stilling basin consists of a small scour hole eroded into the natural valley alluvium. No abnormal nor detrimental erosion was noted in the scour hole. Surface runoff is cutting gulleys on each side of the pipe outlet. Photos 12 and 13 show the scour hole.
2. North Dam. There is no stilling basin (or scour hole) for the principal spillway. No significant erosion was observed at the outlet of the conduit. It should be noted that the normal pool level of the adjoining Tanglewood South Reservoir (MO 31224) is about 1 foot higher than the outlet invert elevation of this reservoir. This undoubtedly accounts for the lack of erosion at the outlet of this structure. Photo 33 shows the outlet of the pipe spillway conduit.

(2) Emergency Spillway.

- (a) South Dam. The emergency spillway consists of a low swag in the crest on the left end of the dam. The control section of the spillway consists of the 20-foot wide concrete roadway that passes over the dam. A few small willows are growing on the right side of the inlet section. The discharge from the spillway flows down the left abutment trough and the left downstream slope of the dam. There was no indication that the spillway has operated. Photos 17 and 18 show the emergency spillway.
 - (b) North Dam. The emergency spillway consists of a narrow channel cut through the right abutment. Trees and brush are growing in both the inlet and outlet channels. The spillway channel is well vegetated with grass, and no significant erosion was observed. It appeared that small flows had passed through the spillway. The spillway discharges into the right abutment trough, and high flows would probably encroach upon the toe of the embankment. The profile of the crest indicates that the low area on the left abutment would also serve as an emergency spillway. Photos 34, 35 and 36 show the emergency spillway.
- (3) Low-Level Outlet. There is no low-level or drawdown facility for either of the two dams.

d. Reservoir Area.

- (1) South Dam. The area around the reservoir is well vegetated. No slumps or slides were evident around the reservoir. No significant erosion was observed along the shoreline and there was no evidence of siltation. Photo No. 10 shows a portion of the reservoir. Lake Tanglewood North Dam (MO 31225) shows in the background.
- (2) North Dam. The area around the reservoir is well vegetated. No slumps or slides were evident around the reservoir. No significant erosion was observed along the shoreline. There was no evidence of siltation in the reservoir. Photo No. 30 shows a portion of the reservoir area.

e. Downstream Channel.

- (1) South Dam. The channel downstream from the principal spillway is overgrown with brush and trees. However, this should not significantly affect the operation of the pipe spillway. There is no distinct channel for the emergency spillway. It discharges over the slope of the embankment and into the left abutment trough. Photos 1 and 9 show the downstream channel.
- (2) North Dam. There is no downstream channel for the principal spillway. At normal pool levels, all discharges from this dam will pass directly into the Tanglewood South Reservoir (MO 31224).

3.2 EVALUATION

- a. South Dam. This dam appears to be in relatively good condition. The embankment slopes of 1V on 3H, the lack of abnormal deformations and the lack of seepage on the downstream side would indicate that it is safe against seepage and piping and against static shear stresses. The effects of dynamic (earthquake) loadings on the embankment are not known. The effects of overtopping are not known, but it would appear that discharges through the emergency spillway on the left end and over the low crest area on the right end could cause considerable erosion in the abutment troughs and on the downstream slope of the dam. Gully erosion from surface runoff into the principal spillway scour hole along both sides of the pipe outlet could ultimately result in damage to the pipe. Tree growth and rodent activity on the embankment could ultimately impair the stability of the dam and should be remedied and controlled. Mowing the downstream slope would facilitate rodent control and better observation of other potential deficiencies.
- b. North Dam. This dam appears to be in good condition with no serious potential of failure. The 1V on 3+H slopes of the embankment should provide adequate safety against failures for a dam of this height. No seepage was evident on the downstream slope or along the toe of the dam. Tree growth and rodent activity on the upstream slope could ultimately impair the stability of the dam. Tree growth in the inlet section of the emergency spillway could affect spillway operation.

The effects of overtopping on the stability of this structure are not known. However, the silty nature (ML) of the material in the dam would indicate that overtopping would probably cause considerable damage to this dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for either of the two dams. The pool levels are controlled by rainfall, infiltration, evaporation, the capacity of the uncontrolled spillways. Discharges from Lake Tanglewood North (MO 31225) flow into the reservoir formed by Lake Tanglewood South Dam.

4.2 MAINTENANCE OF DAM

- a. South Dam. Maintenance of the structure is fair. The trees on the upstream slope and in the emergency spillway channel should be removed. The rodents should be eliminated. The erosional gulleys around the outlet pipe should be repaired and the downstream slope mowed.
- b. North Dam. Maintenance appears to be reasonably good. The downstream slope was mowed. Tree growth and rodent activity on the dam and in the spillway should be controlled.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at these dams.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for these dams.

4.5 EVALUATION

- a. South Dam. The deficiencies observed during the inspection can be corrected with an improvement in the maintenance program.
- b. North Dam. There are no operating facilities for this dam. Maintenance is reasonably good but should include control of tree growth and rodent activity on the structure.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. No design data were found for these dams.
- b. Experience Data. The drainage areas, reservoir surface areas, and elevation-storage data were developed from the USGS Cape Girardeau, Missouri 7-1/2 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection. Hydraulic/hydrologic computations are included as Appendix D of this report.
- c. Visual Observations.
 - (1) South Dam.
 - (a) The principal spillway appeared to be in good condition. The trash rack is considered to be adequate, and no debris was observed around the inlet. There was some deterioration of the bituminous coating covering the pipe.
 - (b) The emergency spillway had trees located both in the entrance and exit channels. The crest had recently been paved. The upstream or entrance channel was sparsely vegetated. Flows through the spillway could endanger the integrity of the dam, if continued for an extended period of time, due to the nature of the material in the embankment and the fact that flows are released over the downstream slope of the dam embankment.
 - (c) Lake Tanglewood North Dam (MO 31225) is located immediately upstream of Lake Tanglewood South Dam on the same drainage channel. All releases from the upper reservoir flow into the Lake Tanglewood South reservoir.
 - (d) There are no drawdown facilities for this structure.
 - (2) North Dam.
 - (a) The principal spillway appeared to be in good condition. The trash rack is considered to be adequate, and no debris was noticed around the inlet. There was some deterioration of the bituminous coating covering the pipe with some appearance of rust in a few places.
 - (b) The emergency spillway appeared to have had some flow through it. The entrance had some willow trees growing along the normal pool waterline. The spillway channel just downstream of the centerline of the dam was choked with brush and weeds.
 - (c) All discharges, from both the principal and emergency spillways, would be released into Lake Tanglewood South Reservoir (MO 31224) immediately downstream of Lake Tanglewood North Dam.

(d) There are no drawdown facilities available for this dam.

d. Overtopping Potential.

- (1) South Dam. The hydrologic routing of this structure consisted of a multiple dam analysis, taking into consideration Lake Tanglewood North Dam. Sufficient field data were collected for the upstream dam to route the probable maximum flood (PMF) through it. It was determined that the upstream dam's spillways would only pass 9% of the PMF without overtopping. The upstream flood was therefore routed through Lake Tanglewood South Dam, both without breaching and with breaching. The results of the routings did not give significant differences for the PMF or 50% of the PMF. However, there was a difference in the lower ratios as shown in the table below:

<u>Frequency</u>	<u>*Maximum Depth Over Dam (Feet)</u>	<u>Duration Over Top (Hours)</u>
0.15 PMF - No Breach	0	0
Breach	0.2	1-
0.25 PMF - No Breach	0	0
Breach	0.3	1±
0.50 PMF - No Breach	0.6	1±
Breach	0.5	2±
PMF - No Breach	1.0	5-
Breach	0.9	6-

The routings with breaching of Lake Tanglewood North Dam are more severe at the lower frequency ratios; therefore, the routings with breaching shall be used to determine the hydrologic capabilities of the Lake Tanglewood South Dam.

The spillways for Lake Tanglewood South Dam are too small to pass 50 percent of the probable maximum flood without overtopping the dam. The spillways will pass 10% of the probable maximum flood and the 1% probabilistic flood without overtopping the dam. Overtopping is dangerous because the flow of water over the crest could erode the face of the dam and, if continued long enough, could breach the dam with sudden release of all of the impounded water into the downstream floodplain.

The results of the routings through the dam are tabulated in regards to the following conditions:

<u>Frequency</u>	<u>Inflow Discharge c.f.s.</u>	<u>Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>*Maximum Depth Over Dam Feet</u>	<u>Duration Over Top Hours</u>
1% Flood	55	10	469.8	0	0
1/2 PMF	450	425	473.4	0.5	2-
PMF	925	920	473.8	0.9	6-
0.10 PMF	180	140	472.8	0	0

* Minimum top of dam elevation - 472.9

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and a small size. Therefore, the 1/2 PMF is the test for the adequacy of the dam and its spillways.

- (2) North Dam. The spillways are too small to pass 50% of the probable maximum flood without overtopping the dam. The spillways will pass the 1% probability flood as well as 9% of the probable maximum flood without overtopping the dam. Overtopping is dangerous because the flow of water over the crest could erode the face of the dam and, if continued long enough, could breach the dam with sudden release of all of the impounded water into the downstream floodplain.

The results of the routings through the dam are tabulated in regards to the following conditions:

<u>Frequency</u>	<u>Inflow Discharge c.f.s.</u>	<u>Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>*Maximum Depth Over Dam Feet</u>	<u>Duration Over Top Hours</u>
1% Flood	120	20	488.7	0	0
1/2 PMF	430	410	490.2	1.2	6-
PMF	870	870	490.7	1.7	7±
0.09 PMF	80	30	488.9	0	0

*Minimum top of dam elevation - 489.0

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard potential rating based on downstream hazards. This dam, although not meeting the requirements of the recommended guidelines to qualify as a small size dam, is located immediately upstream from Lake Tanglewood South Dam (MO 31224) which is classified as a small size dam having a high hazard potential rating. Approximately 76% of the water impounded by Lake Tanglewood South Dam must flow through the spillways of this dam. Failure of this dam due to overtopping could cause failure of Lake Tanglewood South Dam with the combined volume of water impounded in both reservoirs being released onto the downstream floodplain. The test for the adequacy of this dam and its spillways is 50% of the probable maximum flood which is the same as the requirement for Lake Tanglewood South Dam (MO 31224).

The estimated damage zone for these dams is described in paragraph 1.2.d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation.

- (1) South Dam. The embankment slopes of 1V on 3H and the lack of any deformation and seepage would indicate that this dam is structurally stable against normal shear and seepage stresses.
- (2) North Dam. Based on visual observation, this dam is considered to be structurally stable. There is no sign of seepage, and the cross section should provide adequate safety against shear failures.

b. Design and Construction Data. No design or construction data were available for the two dams. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. There are no controlled operating facilities for this dam.

d. Post-Construction Changes. The inspection team is not aware of any post-construction changes other than the recent construction of the concrete pavement on the crest of the South Dam.

e. Seismic Stability. These dams are located in Seismic Zone 3. An earthquake of the magnitude predicted in this area might be expected to cause some damage to these dams, but it is unlikely that it would cause failure of dams of this height and cross section.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety.

- (1) South Dam. Based on visual operation, this dam is in generally good condition with no serious potential of failure. Tree growth and rodent activity on the embankment, if allowed to continue, would ultimately impair the stability of the structure. Approximate analyses indicate that the dam would be overtopped by 50% of the probable maximum flood and/or by breaching failure of Lake Tanglewood North Dam (MO 31225). The effects of overtopping are not known, but it would appear that overtopping could cause considerable damage and possible breaching of the dam. Tree growth and rodent activity on the embankment as well as wave erosion of the upstream slope could ultimately impair the integrity of the structure if left uncontrolled. Surface erosion around the outlet of the principal spillway should be repaired and controlled. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
 - (2) North Dam. Based on visual observation, this dam is in good structural condition with no serious potential of failure from the structural standpoint. However, heavy emergency spillway flows and/or overtopping might cause breaching of the dam in a relatively short time. Breaching of the reservoir could cause overtopping and possible failure of the Lake Tanglewood South Dam (MO 31224) immediately downstream from this structure. Tree growth and rodent activity on the embankment could ultimately impair the integrity of the structure if left uncontrolled. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- b. Adequacy of Information. No design or construction data were available. The performance history and information collected during the inspection of these dams are considered adequate to support the conclusions presented in this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Urgency. A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2.b should be accomplished in the near future. The item recommended in paragraph 7.2.a should be pursued on a high priority basis.

- d. Necessity for Further Investigations. The seepage and stability analyses recommended in paragraph 7.2b should be accomplished by the owner in the near future.
- e. Seismic Stability. These dams are located in Seismic Zone 3. An earthquake of this magnitude could be expected to cause some damage to these dams. It is recommended that the prescribed seismic loading for Seismic Zone 3 be applied in any stability analyses performed for these dams.

7.2 REMEDIAL MEASURES

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a registered professional engineer experienced in the design and construction of earth dams.

a. Alternatives.

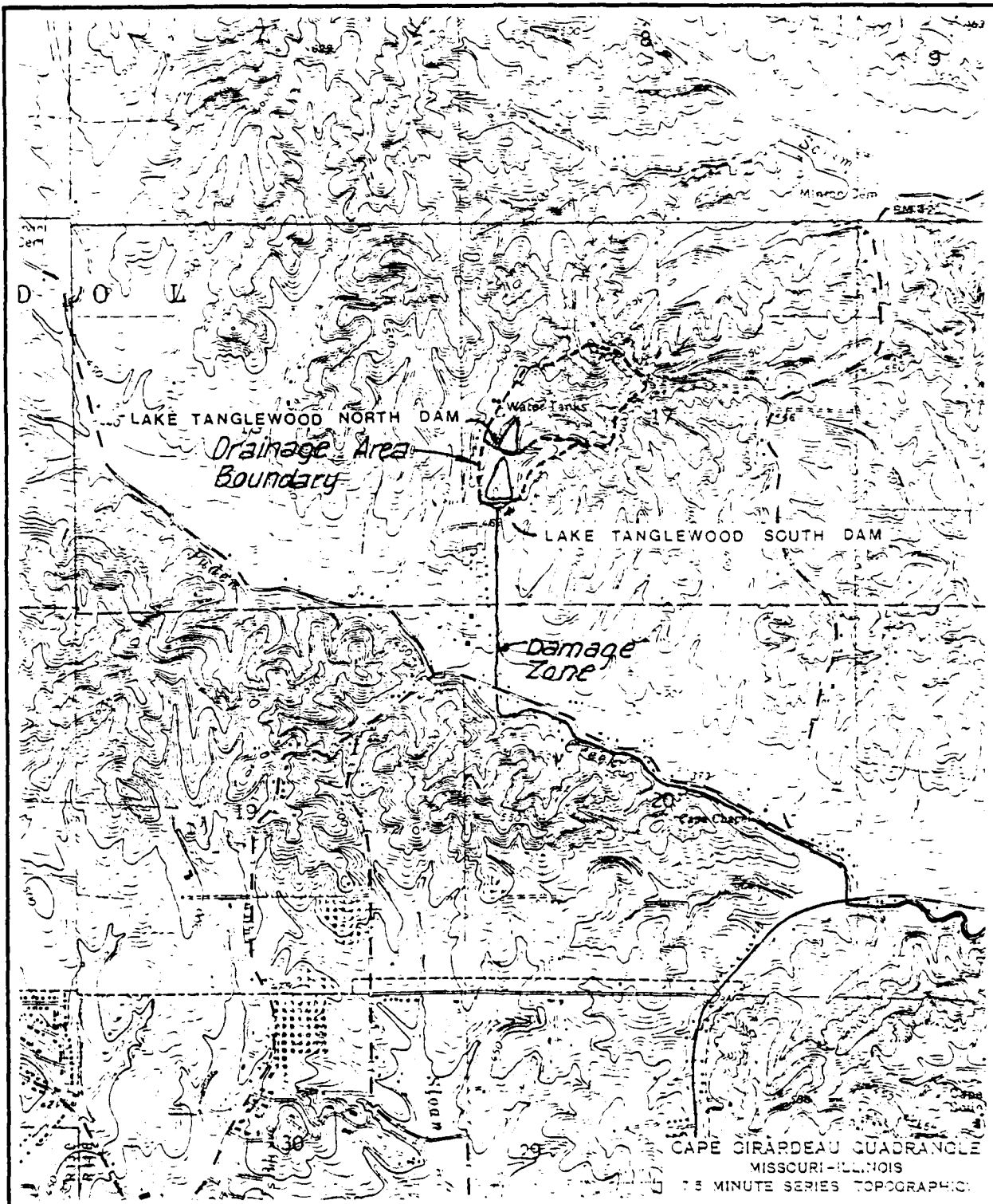
- (1) It is recommended that the height of dam and/or the spillway size be increased on both of the dams in order to pass 50% of the probable maximum flood without overtopping the dams. In either case, the spillways should be protected to prevent erosion and to prevent encroachment of spillway discharges upon the downstream section of the dams.

b. Operation and Maintenance Procedures.

- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed for both dams by an engineer experienced in the design and construction of dams. These analyses should include the prescribed seismic loading for Seismic Zone 3.
- (2) Tree growth should be removed from both of the embankments and spillway channels and measures taken to prevent recurrent growth. Removal of large trees should be under the guidance of an engineer experienced in the design and construction of earthen dams.
- (3) Rodent holes on both of the embankments should be repaired and measures taken to eliminate rodent activity.
- (4) Both of the embankments should be mowed periodically.
- (5) The gulleys entering the scour hole at the outlet end of the South Dam principal spillway conduit should be repaired and/or stabilized.
- (6) The wave erosion on the upstream slope of the South Dam should be monitored on a periodic basis.

- (7) The possibility of seepage occurring along the North Dam principal spillway conduit should be monitored on a periodic basis.
- (8) A program of periodic inspection and maintenance designed to cover the above items should be initiated and copies of the inspection reports made a part of this project file.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

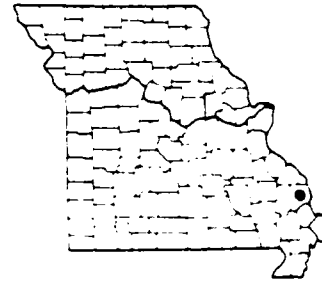
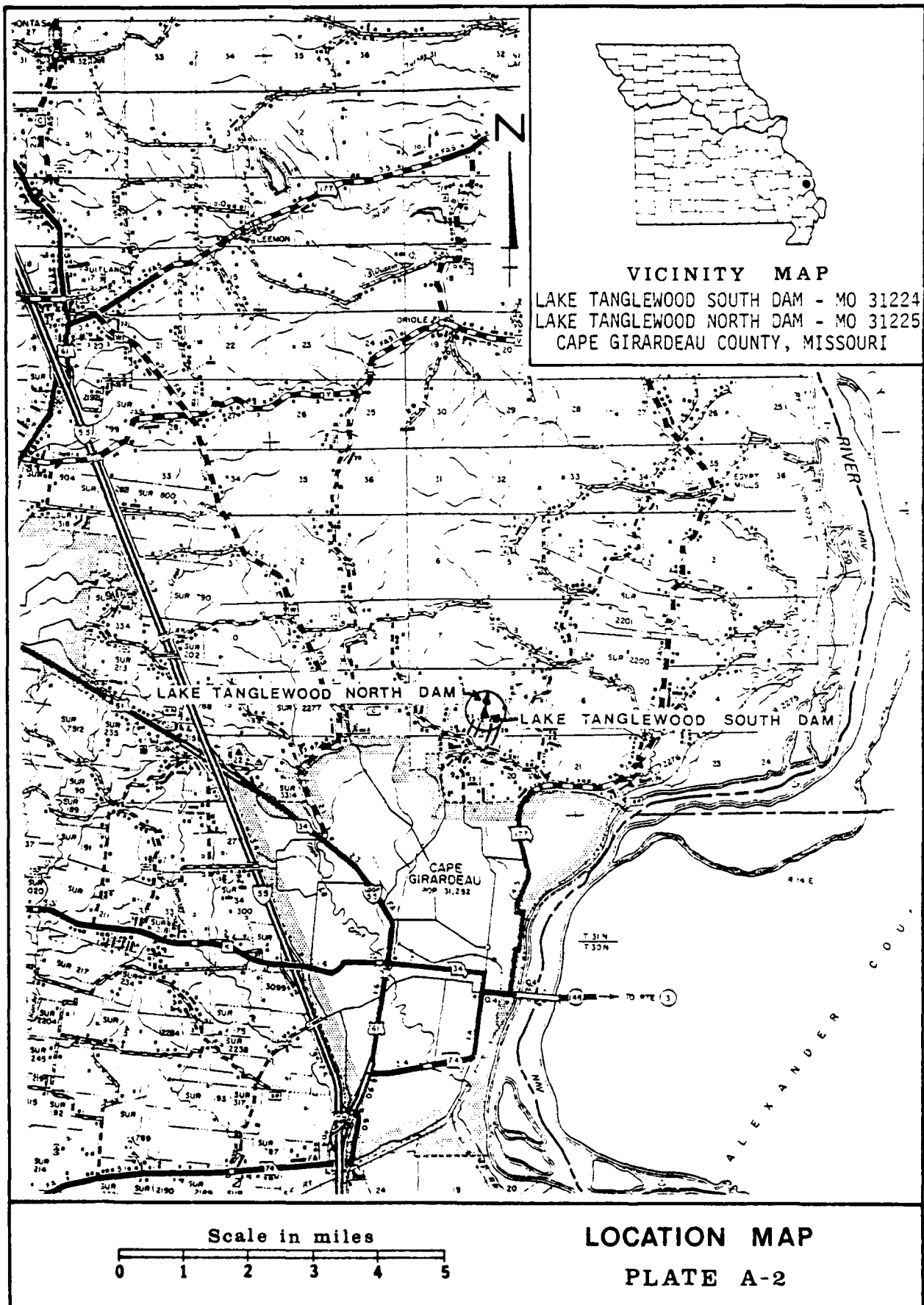
Contour Interval - 10'



VICINITY TOPOGRAPHY

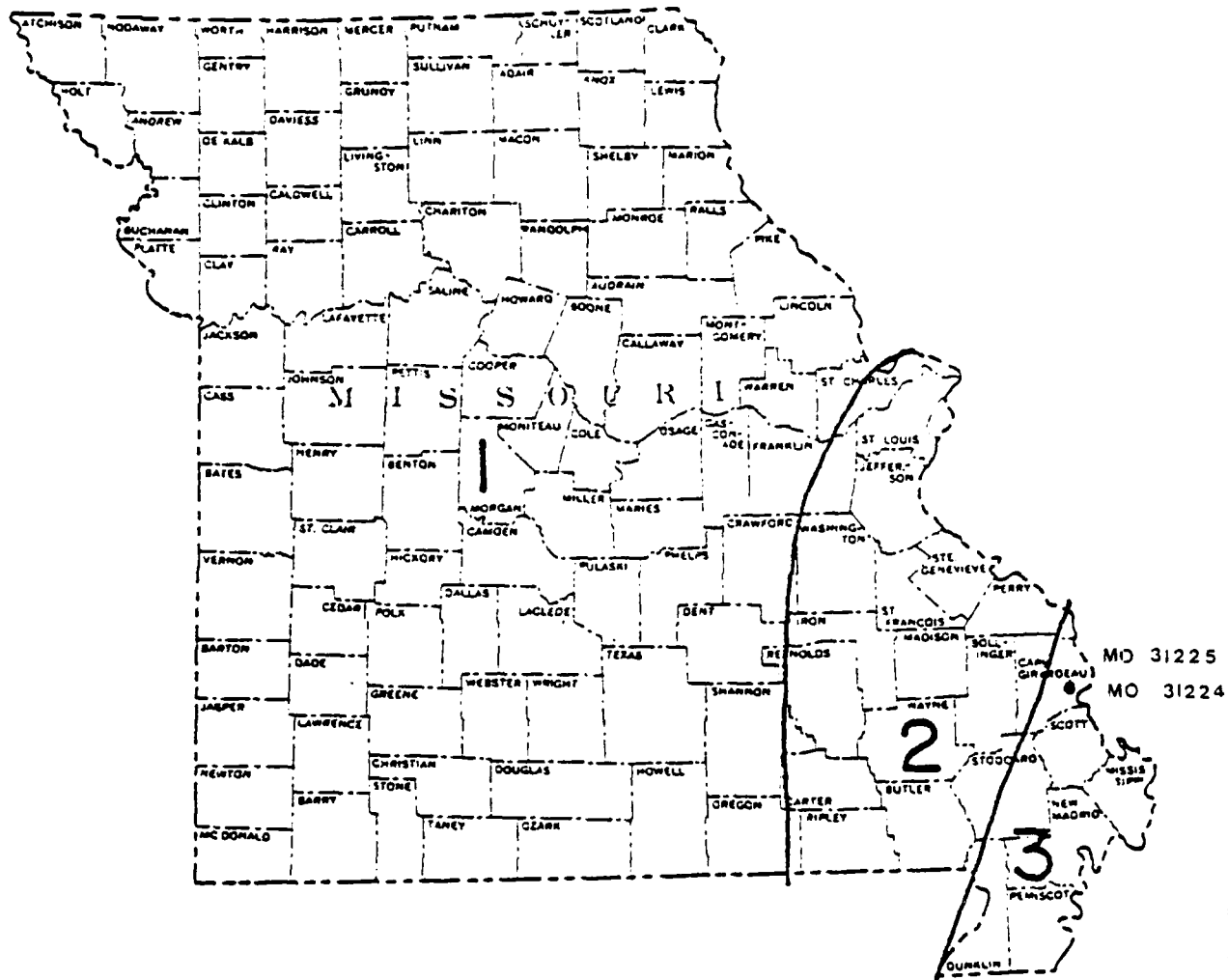
LAKE TANGLEWOOD SOUTH DAM MO 31224
LAKE TANGLEWOOD NORTH DAM MO 31223
CAPE GIRARDEAU COUNTY, MISSOURI

PLATE A-1



VICINITY MAP

LAKE TANGLEWOOD SOUTH DAM - MO 31224
LAKE TANGLEWOOD NORTH DAM - MO 31225
CAPE GIRARDEAU COUNTY, MISSOURI



MISSOURI
SEISMIC ZONE MAP

APPENDIX B
PHOTOGRAPHS



LAKE TANGLEWOOD SOUTH DAM
CAPE GIRARDEAU COUNTY, MISSOURI
MO 31224

PHOTO INDEX

PLATE B-1



PHOTO NO. 2 - OVERVIEW TAKEN FROM THE RIGHT SIDE



PHOTO NO. 3 - UPSTREAM SLOPE TAKEN FROM THE RIGHT END



PHOTO NO. 4 - UPSTREAM SLOPE TAKEN FROM THE RIGHT END



PHOTO NO. 5 - CREST OF DAM TAKEN FROM RIGHT END



PHOTO NO. 6 - SPILLWAY CREST TAKEN FROM THE DOWNSTREAM SLOPE
ON THE RIGHT SIDE OF THE DAM



PHOTO NO. 7 - DOWNSTREAM SLOPE TAKEN FROM THE RIGHT END



PHOTO NO. 8 - DOWNSTREAM SLOPE TAKEN FROM THE LEFT END



PHOTO NO. 9 - LOOKING DOWNSTREAM AT ABOUT THE PIPE SPILLWAY



PHOTO NO. 10 - LOOKING UPSTREAM OVER THE PIPE SPILLWAY.
NOTE UPPER DAM IN THE BACKGROUND

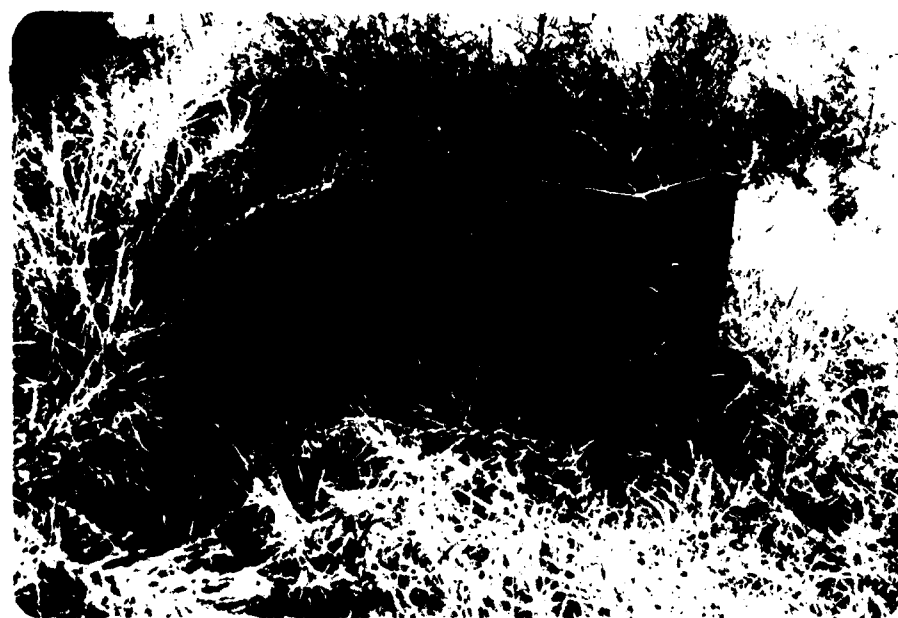


PHOTO NO. 11 - INLET AND TRASH RACK FOR THE PIPE SPILLWAY



PHOTO NO. 12 - OUTLET OF THE
PIPE SPILLWAY AND THE CHANNEL
LOOKING DOWNSTREAM

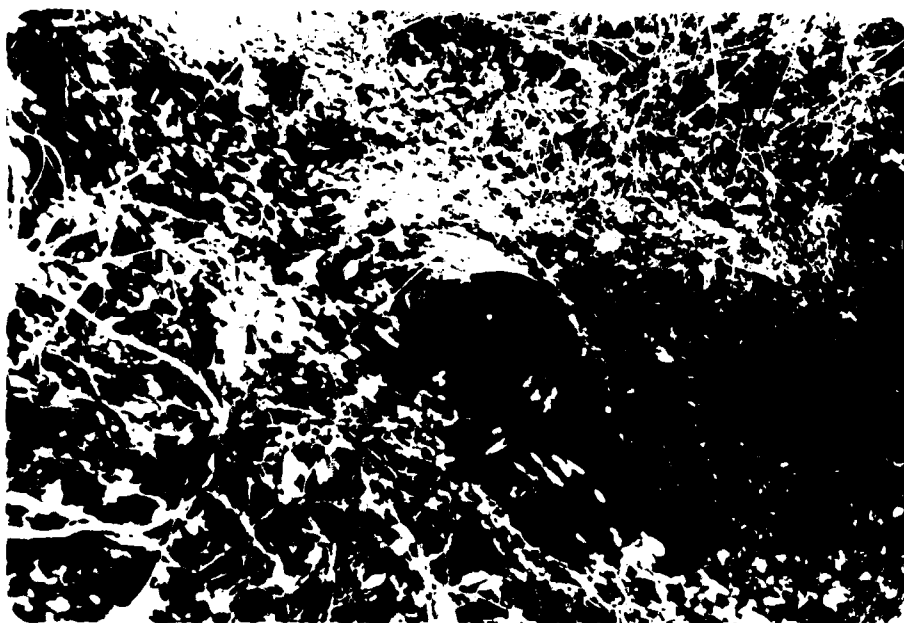


PHOTO NO. 13 - OUTLET OF THE PIPE SPILLWAY



PHOTO NO. 14 - GULLY COMING IN ON THE RIGHT SIDE OF THE
OUTLET PIPE



PHOTO NO. 15 - GULLY COMING IN ON THE LEFT SIDE OF THE PIPE
SPILLWAY



PHOTO NO. 16 - GULLY COMING
IN ON THE LEFT SIDE OF THE
PIPE SPILLWAY



PHOTO NO. 17 - LOOKING UPSTREAM INTO THE EMERGENCY SPILLWAY
TAKEN FROM THE EXIT CHANNEL



PHOTO NO. 18 - LOOKING DOWNSTREAM INTO THE EMERGENCY
SPILLWAY ON THE LEFT END OF THE DAM. TAKEN FROM THE
ENTRANCE SECTION OF THE SPILLWAY



PHOTO NO. 19 - TWO OR THREE HOUSES ABOUT 0.5 MILES DOWNSTREAM
OF DAM THAT ARE IN POTENTIAL DAMAGE ZONE



PHOTO NO. 20 - BACK OF THE 10TH HOUSE DOWNSTREAM OF THE DAM
ON THE EAST SIDE OF THE ROAD



PHOTO NO. 21 - CHURCH AND HOUSE ABOUT 0.5 MILES DOWNSTREAM
JUST BEFORE CHANNEL ENTERS INTO MAIN DRAINAGEWAY (JUDEN
CREEK).



PHOTO NO. 22 - THREE HOUSES ON THE SOUTH SIDE OF THE ROAD
ABOUT 0.5 MILES DOWNSTREAM OF DAM



PHOTO NO. 23 - SHALEY LIMESTONE EXPOSED IN CREEK BED OF JUDEN
CREEK ABOUT 3/4 OF MILE DOWNSTREAM OF DAM



LAKE TANGLEWOOD NORTH DAM
CAPE GIRARDEAU COUNTY, MISSOURI
MO 31225

PHOTO INDEX

PLATE B-13



PHOTO NO. 24 - OVERVIEW TAKEN FROM THE LEFT SIDE



PHOTO NO. 25 - CREST TAKEN FROM THE RIGHT END



PHOTO NO. 26 - UPSTREAM SLOPE TAKEN FROM LEFT END



PHOTO NO. 27 - DOWNSTREAM SLOPE TAKEN FROM THE RIGHT END



PHOTO NO. 28 - DOWNSTREAM SLOPE TAKEN FROM LEFT END



PHOTO NO. 29 - LOOKING DOWNSTREAM FROM CREST NEAR PRINCIPAL
SPILLWAY. LOWER TANGLEWOOD LAKE IN THE BACKGROUND



PHOTO NO. 30 - LOOKING UPSTREAM OVER THE PIPE SPILLWAY



PHOTO NO. 31 - INLET OF THE PRINCIPAL SPILLWAY



PHOTO NO. 32 - OUTLET
OF PRINCIPAL SPILLWAY



PHOTO NO. 33 - OUTLET OF PRINCIPAL SPILLWAY



PHOTO NO. 34 - EMERGENCY SPILLWAY ON RIGHT END TAKEN FROM
UPSTREAM



PHOTO NO. 35 - LOOKING UPSTREAM IN EMERGENCY SPILLWAY ON
RIGHT END



PHOTO NO. 36 - LOOKING DOWNSTREAM IN EMERGENCY SPILLWAY
ON RIGHT END

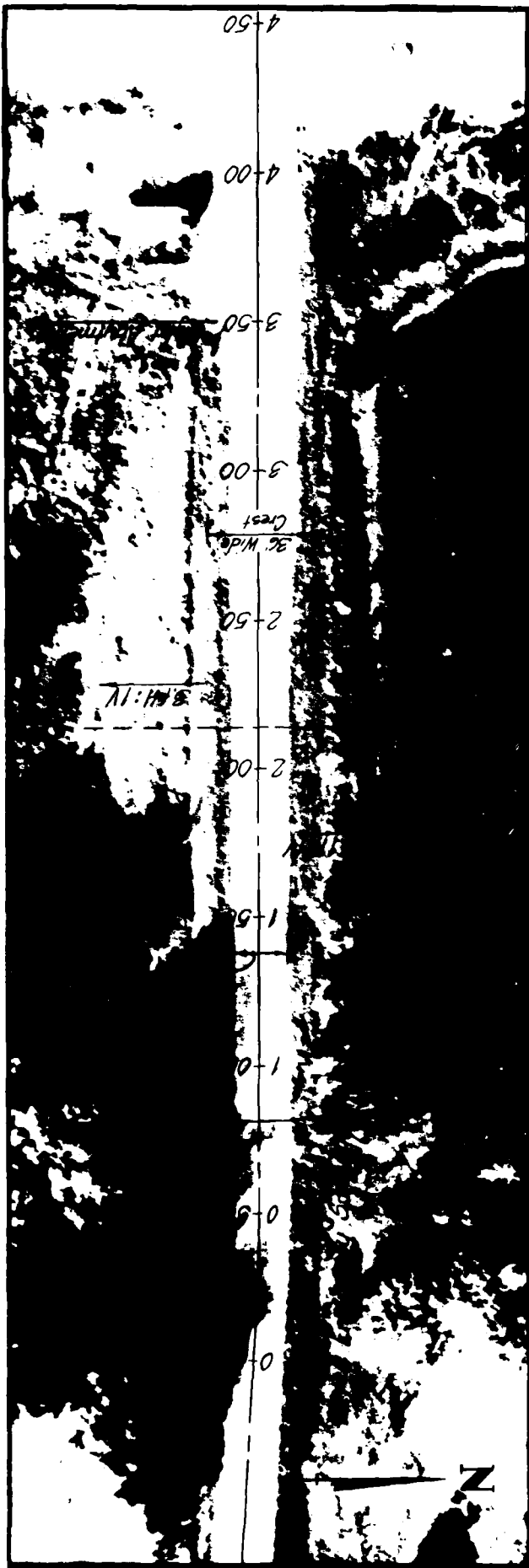


PHOTO NO. 37 - LEFT ABUTMENT LOOKING INTO RESERVOIR



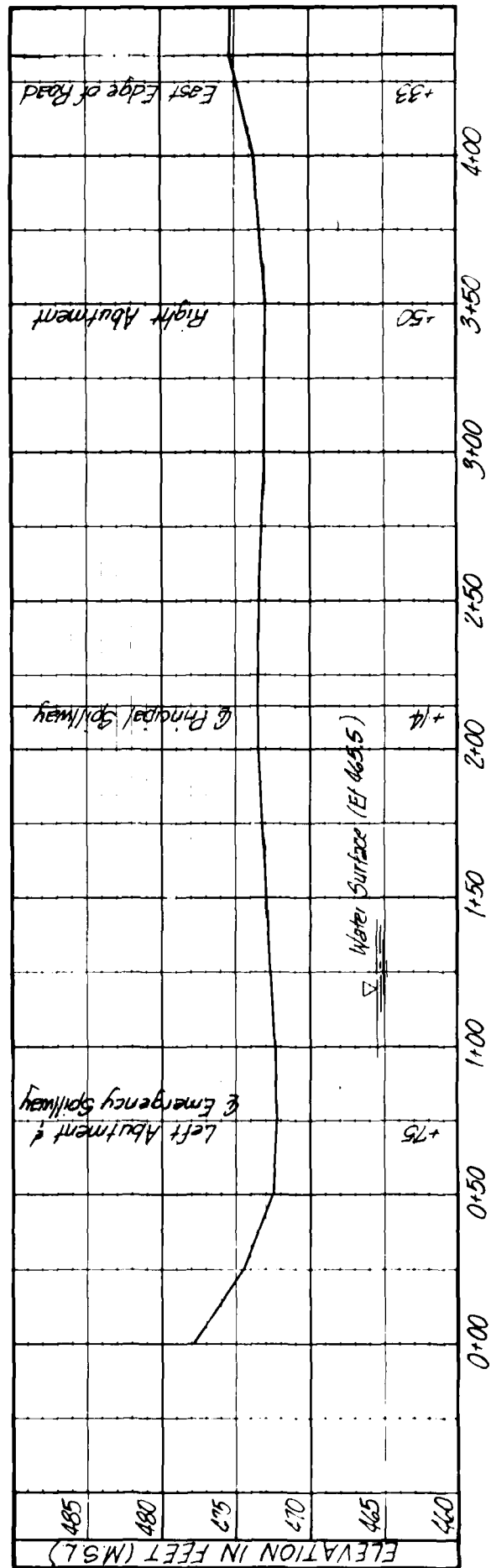
PHOTO NO. 38 - OVERVIEW OF LOWER LAKE TAKEN FROM THE CREST OF
UPPER DAM

APPENDIX C
PROJECT PLATES



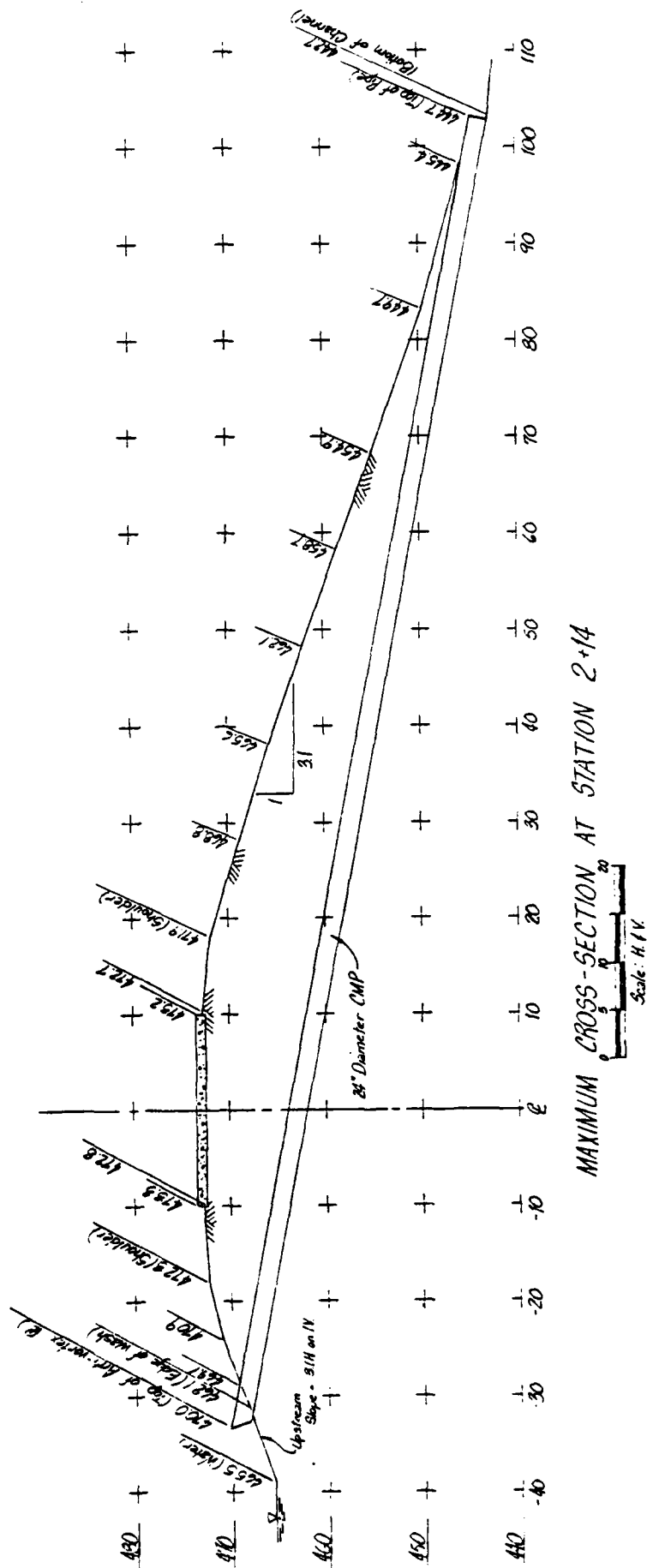
LAKE TANGLEWOOD SOUTH DAM

PLAN OF DAM
Scale: 1"=50'



CENTERLINE PROFILE OF DAM

Scale As Shown

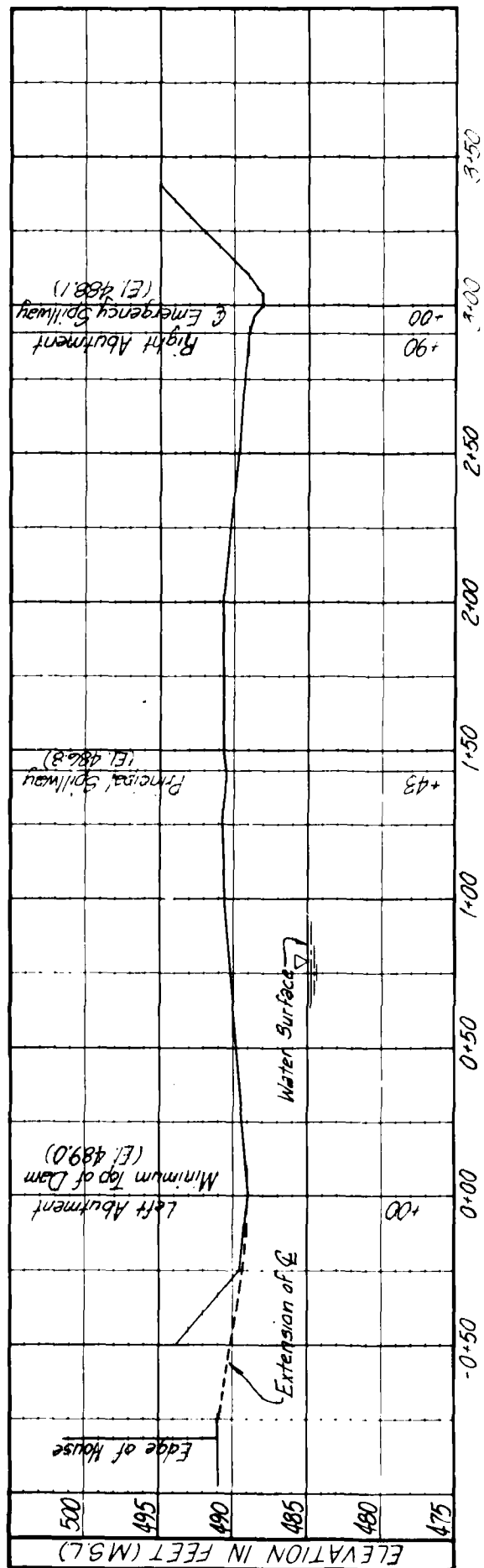


MAXIMUM CROSS-SECTION AT STATION 2+14

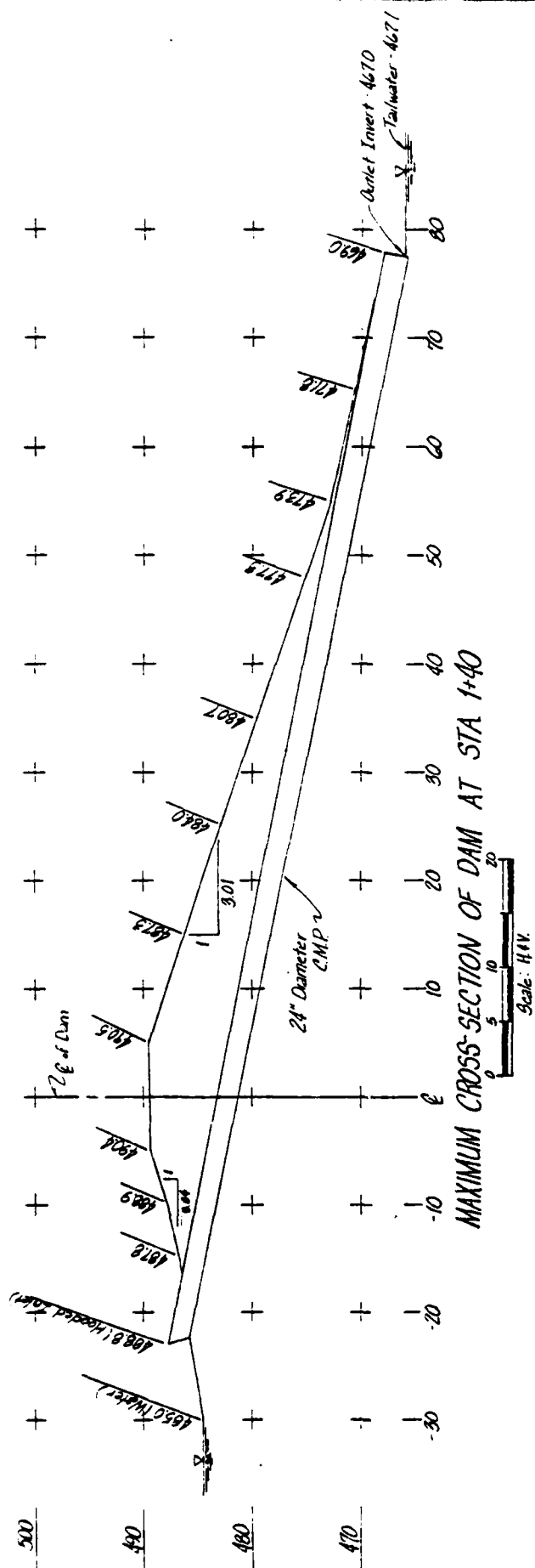
LAKE TANGLEWOOD SOUTH DAM



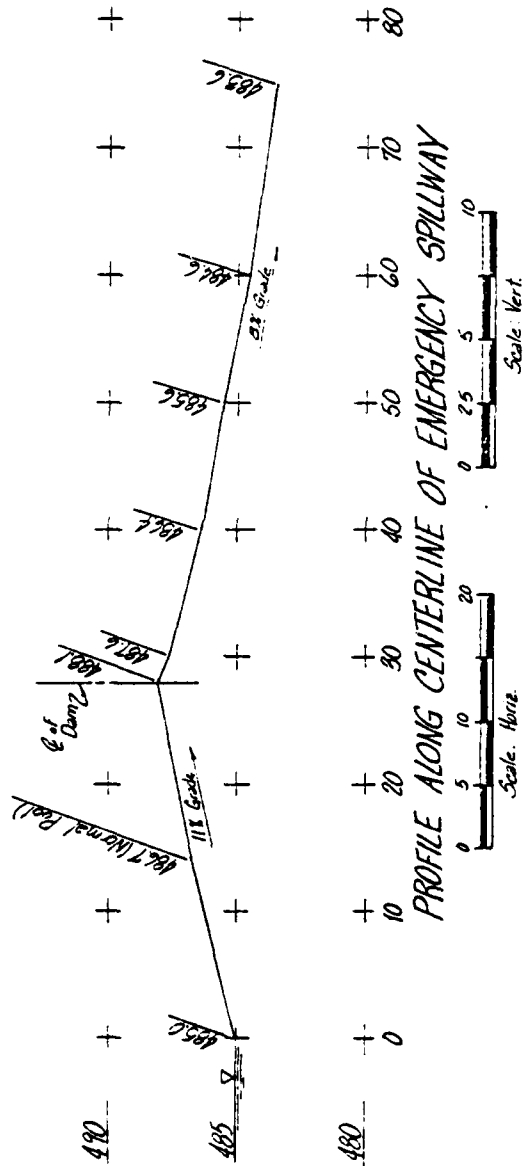
PLAN OF DAM
Scale: 1" = 50'



CENTERLINE PROFILE OF DAM
Scale As Shown

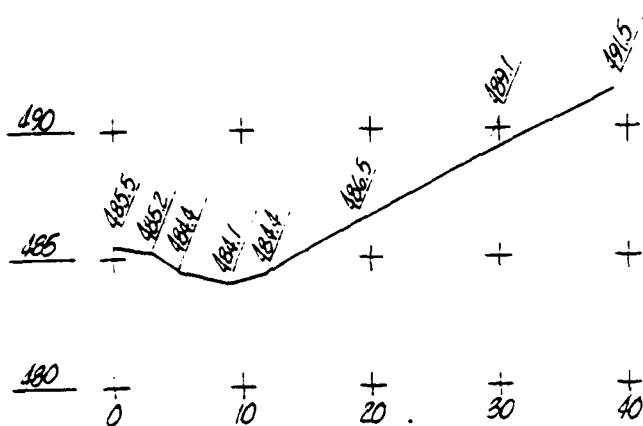


MAXIMUM CROSS-SECTION OF DAM AT STA 1+40

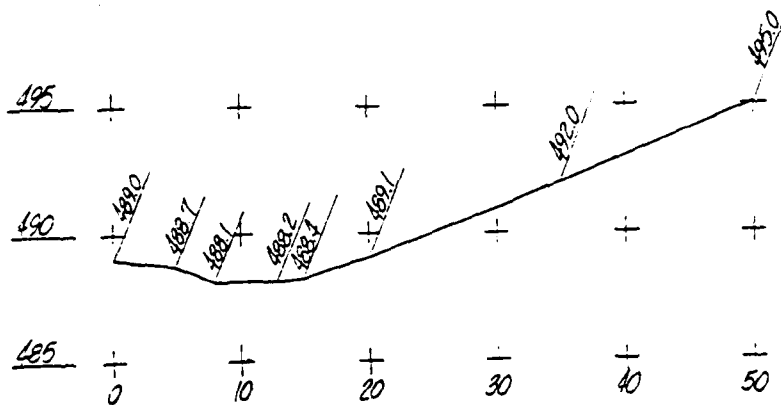


PROFILE ALONG CENTERLINE OF EMERGENCY SPILLWAY

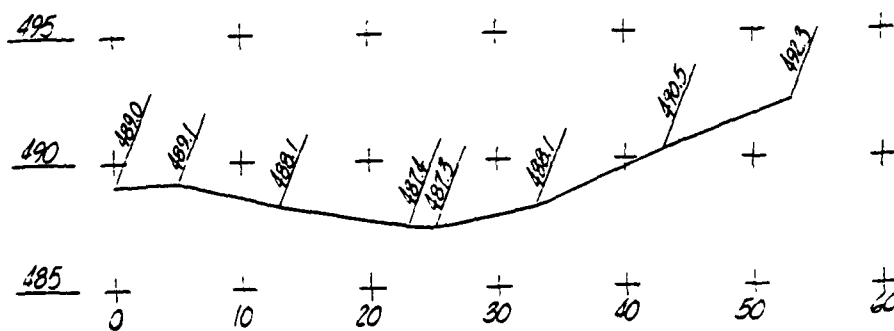
LAKE TANGLEWOOD NORTH DAM



Spillway Cross-Section 35' Downstream of Q



Spillway Cross-Section At Q of Dam



Spillway Cross-Section 8' Upstream of Q

EMERGENCY SPILLWAY CROSS-SECTIONS

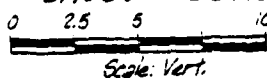
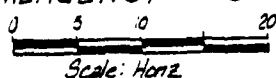


PLATE C-5

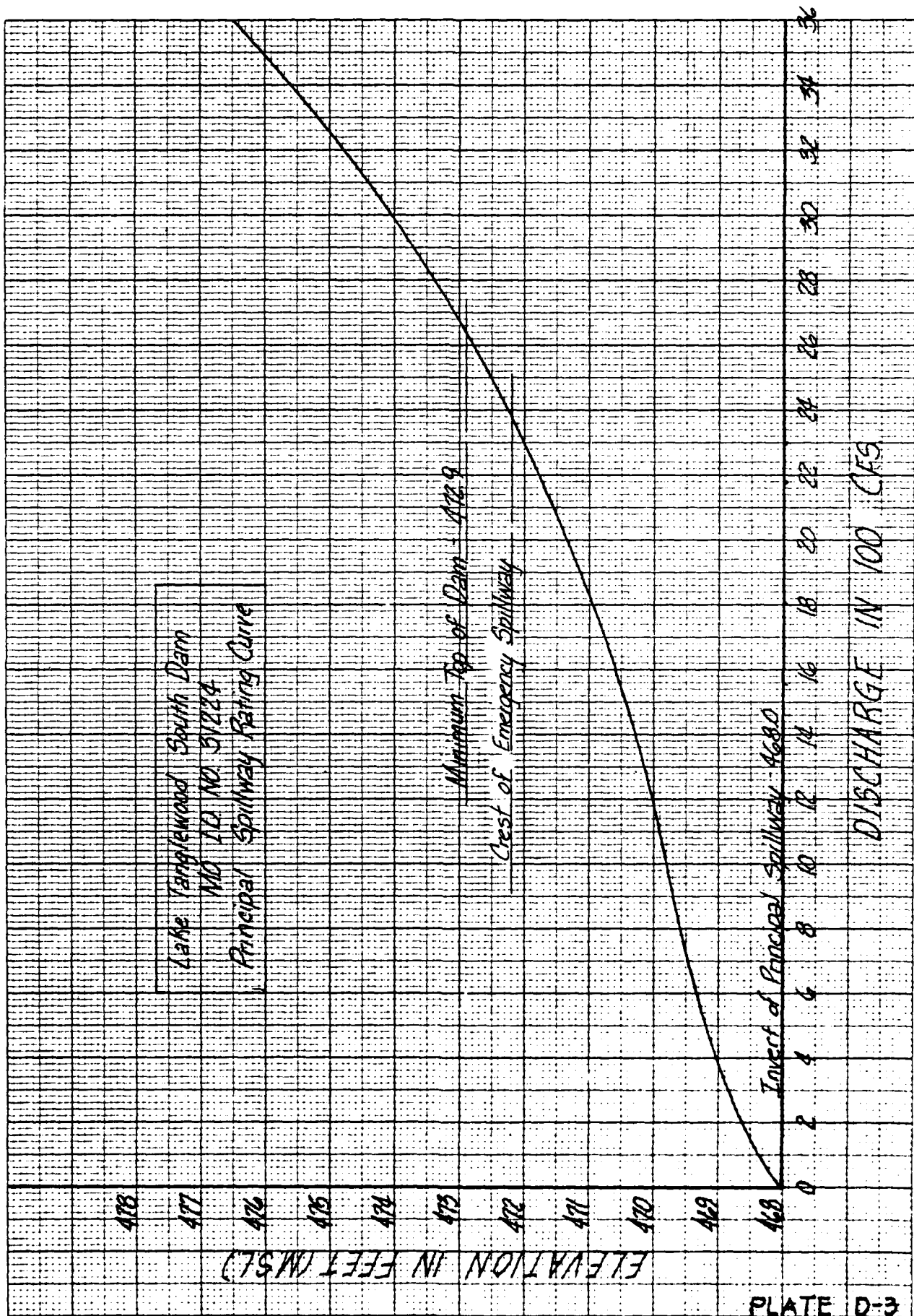
APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

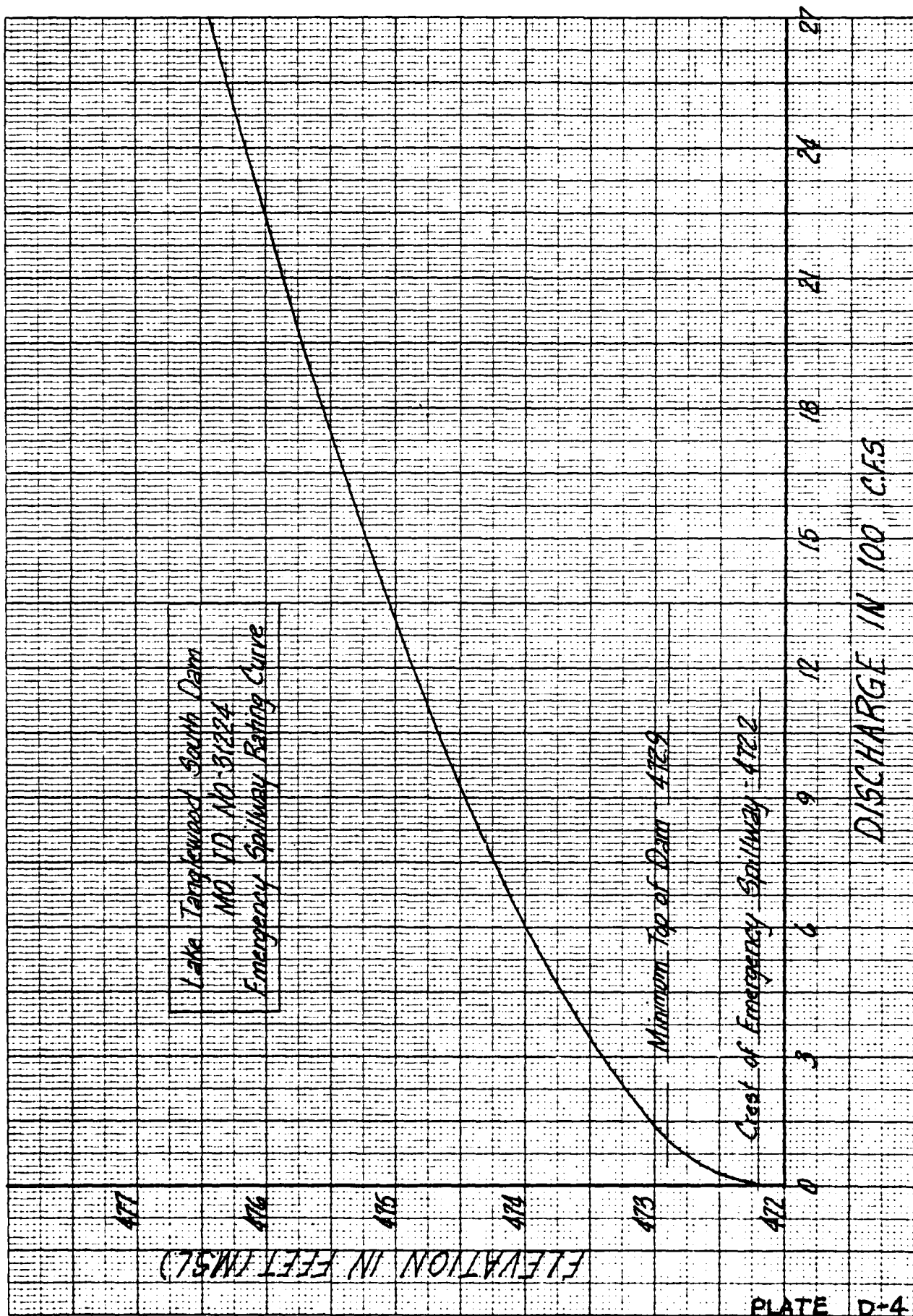
HYDROLOGIC COMPUTATIONS

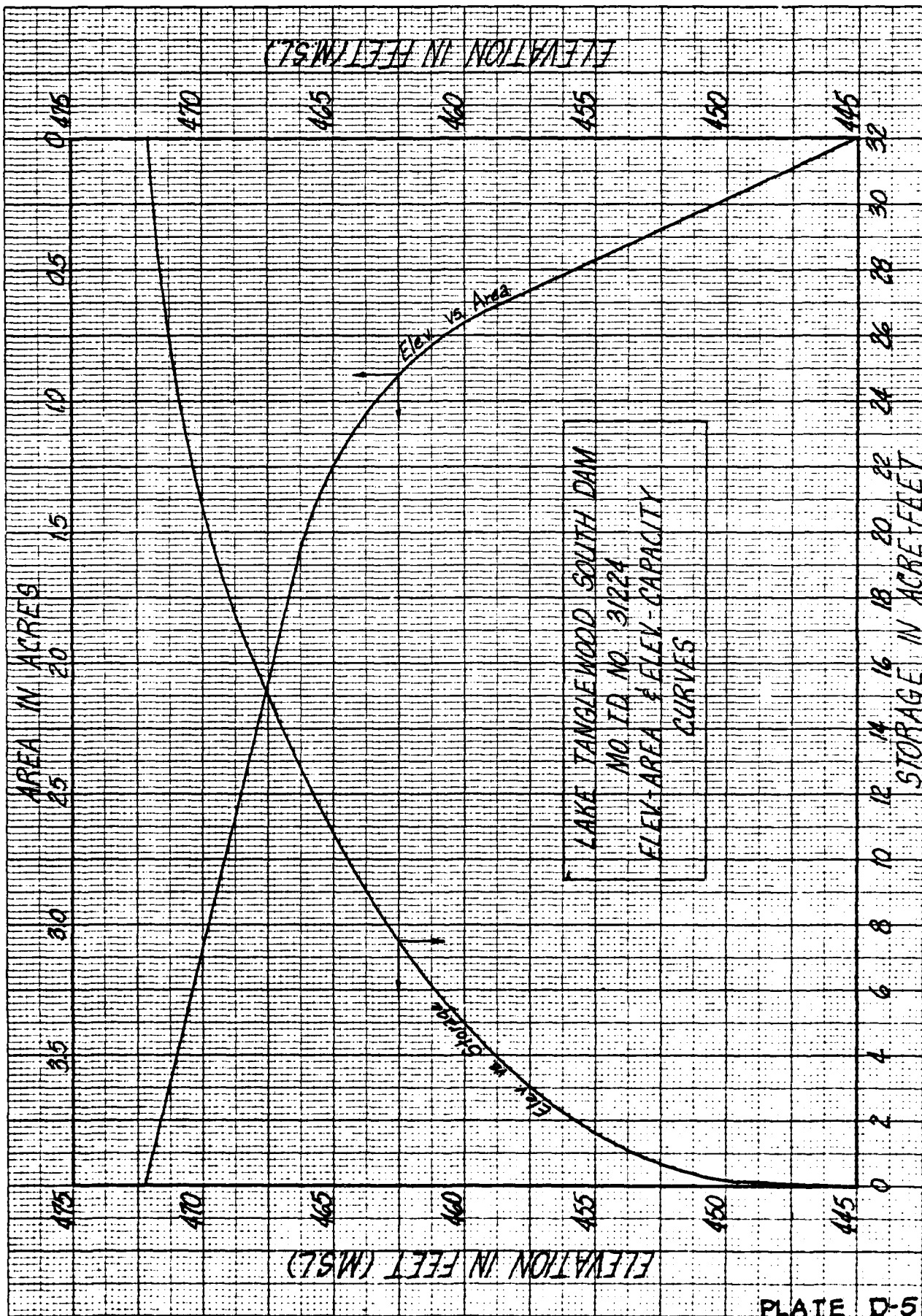
1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (see this section).
 - a. Twenty-four hour, one percent probabilistic rainfall for the dam locations was taken from the data for the rainfall station at Cape Girardeau, Missouri, as supplied by the St. Louis District, Corps of Engineers, per their letter dated 5 December 1980. The twenty-four hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.
 - b. Drainage area: Total drainage area = 59 acres (0.09 square miles)
Lake Tanglewood North reservoir drainage area = 45 acres (0.07 square miles)
Lake Tanglewood South reservoir drainage area = 14 acres (0.02 square miles)
 - c. Time of concentration of runoff = 8 minutes (Lake Tanglewood North reservoir) and 5 minutes (Lake Tanglewood South reservoir). The time of concentration was computed from the "Kirpich" formula and verified using the equation from the California Culverts Practice, California Highways and Public Works Department. Time of concentration for the total area (assuming no upper dam or reservoir) = 11 minutes.
 - d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the one percent probabilistic precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the invert of the principal spillways.
 - e. Lake Tanglewood North Reservoir Losses: The total twenty-four hour storm duration losses for the one percent probabilistic storm were 4.42 inches. The total losses for the PMF storm were 3.17 inches. These data are based on SCS runoff curves No. 60 and No. 78 for antecedent moisture conditions SCS AMC II and AMC III respectively. The watershed is composed of primarily SCS soil groups Menfro and Clarksville (hydrologic soil group "B"). Heavy, thick woods cover the majority of the watershed area with some residential development around the reservoir.

Lake Tanglewood South Reservoir Losses: The total twenty-four hour storm duration losses for the one percent probabilistic storm were 3.61 inches. The total losses for the PMF storm were 2.34 inches. These data are based on SCS runoff curves No. 68 and No. 83 for antecedent moisture conditions SCS AMC II and AMC III respectively. The watershed is composed of primarily SCS soil groups Menfro and Clarksville (hydrologic soil group "B"). Heavy, thick woods cover the majority of the watershed area with some residential development around the reservoir.

- f. Average soil loss rates = 0.09 to 0.13 inch per hour approximately (for PMF storm, AMC III).
2. The combined discharge rating for both Lake Tanglewood Dams consisted of three components: the flow through the principal spillway, the flow through the emergency spillway and the flow going over the top of the dam.
- a. The principal spillway rating for both dams was developed by using culvert flow tables for CMP culverts with inlet control as found in FHA-BPR HEC Circ. No. 5.
- b. The emergency spillway discharge rating for Lake Tanglewood South was developed using methods for flow over highway embankments in U.S.G.S. TWRI, Bk. 3, Ch. A-5 (coefficients based on h/L ratios and ranging in value from 2.09 to 3.04, paved road surface, and no submergence).
- The emergency spillway rating curve for Lake Tanglewood North was developed using the Corps of Engineers, Water Surface Profile HEC-2 computer program assuming critical depth just downstream of the centerline of the dam.
- c. The flows over the dams were determined by using the dam overtopping analyses (irregular top of dam) within the HEC-1 (Dam Safety Version) program.
3. Floods were routed through the reservoirs using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillways and dam embankment crests. A 24-hour PMF storm was first routed through the Lake Tanglewood North reservoir using data from the field inspection. The Lake Tanglewood North Dam's spillways did not pass 50% of the PMF; therefore, the Lake Tanglewood North Dam was breached in the routing of Lake Tanglewood South Dam according to current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology. The Lake Tanglewood North Dam was then routed in series with the Lake Tanglewood South Dam using a 24-hour storm to determine the hydrologic capabilities of Lake Tanglewood South Dam. The input, output, and plotted hydrographs are exhibited in this section.







[illegible]

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

ROUTE HYDROGRAPH AT 000001
ROUTE HYDROGRAPH TO 000002
ROUTE HYDROGRAPH AT 000003
CONTINUE 2 HYDROGRAPHS AT M. 2+3
ROUTE HYDROGRAPH TO 000004
END OF NETWORK

 FLOOD HYDROGRAPH PACKAGE (HRL-11)
 DAM SAFETY WORKSHOP JULY 1978
 LAST MODIFICATION 28 FEB 79

RUN DATE 00/12/16.
 TIME 11.02.27.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMR
 PMR ANALYSIS OF SAFETY OF LAKE TANGLEWOOD SO DAM-NO 10 NO 31224
 RATIOS OF PMR RATIO THROUGH THE RESERVOIR

NO	MMK	RAIN	DAY	INR	IMIN	MEIKC	IPLT	IPRT	INSTAN
208	0	5	0	0	0	0	0	5	0
		JUPLN	HWT	LKOPT	THALE				
		5	0	0	0				

MULTI-PLAN ANALYSIS TO BE PERFORMED

NTIUS= .05 .08 .10 .13 .15 .20 .25 .50 1.00

***** SUB-AREA RUNDIFF COMPUTATION *****

CALCULATION OF INFLOW HYDROGRAPH TO NORTH DAM

ISTAQ	ICOMP	ILCON	ITAPE	JPLT	JPRK	INAME	ISTAGE	IAUTO
000001	0	0	0	0	0	1	0	0

INHYG	INUG	TAREA	SNAP	IRSDA	IRSPC	MATIO	ISNOW	ISAME	LOCAL
1	2	.07	0.00	.07	1.00	0.00	0	1	0

SPFE	PMS	N6	N12	N24	R48	R72	R96
0.00	27.00	102.00	121.00	150.00	0.00	0.00	0.00

LKOPT	STKRN	DLTKN	RTIOL	LRAIN	STKKS	RTIOL	STRTL	CNSTL	ALSRX	RTIMP
0	0.00	0.00	1.00	0.00	1.00	-1.00	-78.00	0.00	0.00	0.00

CURVE NO = -78.00 NETWESS = -1.00 EFFECT CN = 78.00

UNIT HYDROGRAPH DATA
 IC= 0.00 LAGE= .17

STRTU= 0.00 RECLSSION DATA
 ORCSM= -.01 RTIOL= 1.00
 UNIT HYDROGRAPH 12 END OF PERIOD UNIDINATES. TC= 0.00 HOURS, LAGE= 7.17 VOL= 1.00 2.
 49. 147. 151. 75. 47. 25. 13. 4.

MO.DA	HR.MN	PERIOD	RAIN	LXLS	LOSS	CMU-OF-PERIOD FLOW	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP
1.01	0.00	1	0.00	0.00	0.00	1.01	12.00	146	23	20	0.00	0.00	41.
1.01	0.00	2	0.00	0.00	0.00	1.01	12.10	147	23	21	0.00	0.00	42.
1.01	0.00	3	0.00	0.00	0.00	1.01	12.20	148	23	21	0.00	0.00	43.
1.01	0.00	4	0.00	0.00	0.00	1.01	12.30	149	23	21	0.00	0.00	97.
1.01	0.00	5	0.00	0.00	0.00	1.01	12.40	150	23	21	0.00	0.00	104.
1.01	0.00	6	0.00	0.00	0.00	1.01	12.50	151	23	21	0.00	0.00	108.
1.01	0.00	7	0.00	0.00	0.00	1.01	13.00	152	23	21	0.00	0.00	112.
1.01	0.00	8	0.00	0.00	0.00	1.01	13.10	153	23	21	0.00	0.00	113.
1.01	0.00	9	0.00	0.00	0.00	1.01	13.20	154	23	21	0.00	0.00	114.
1.01	0.00	10	0.00	0.00	0.00	1.01	13.30	155	23	21	0.00	0.00	115.
1.01	0.00	11	0.00	0.00	0.00	1.01	13.40	156	23	21	0.00	0.00	116.
1.01	0.00	12	0.00	0.00	0.00	1.01	13.50	157	23	21	0.00	0.00	117.
1.01	0.00	13	0.00	0.00	0.00	1.01	14.00	158	23	21	0.00	0.00	118.
1.01	0.00	14	0.00	0.00	0.00	1.01	14.10	159	23	21	0.00	0.00	119.
1.01	0.00	15	0.00	0.00	0.00	1.01	14.20	160	23	21	0.00	0.00	120.
1.01	0.00	16	0.00	0.00	0.00	1.01	14.30	161	23	21	0.00	0.00	121.
1.01	0.00	17	0.00	0.00	0.00	1.01	14.40	162	23	21	0.00	0.00	122.
1.01	0.00	18	0.00	0.00	0.00	1.01	14.50	163	23	21	0.00	0.00	123.
1.01	0.00	19	0.00	0.00	0.00	1.01	15.00	164	23	21	0.00	0.00	124.
1.01	0.00	20	0.00	0.00	0.00	1.01	15.10	165	23	21	0.00	0.00	125.

.....

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

CLAS	PIAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
CLAS	665.	200.	60.	60.	1268.
INCHS	24.	6.	2.	2.	489.
MM		26.56	51.87	51.87	31.87
AL-FT		274.86	809.55	809.55	809.55
THOUS		99.	113.	113.	119.
		122.	147.	147.	147.

HYDROGRAPH AT STATION 001 FOR PLAN 1, KTU 1

	PLAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
CFS	43.	10.	3.	3.	863.
CMS	1.	0.	0.	0.	24.
INCHES		1.33	1.33	1.33	1.33
MM		34.73	40.48	40.48	40.48
AC-FT		5.	6.	6.	6.
THOUS CU M		6.	7.	7.	7.

HYDROGRAPH AT STA00001 FOR PLAN 1. KIU 2

	PLAN	6-HOUR-	24-HOUR-	72-HOUR-	TOTAL	VOLUME
CLS	65.	15.	4.	4.	1295.	
CMS	62.	0.	0.	0.	37.	
INCHLS			1.99	2.39	2.59	
MM		30.60	60.72	60.72	60.72	
AC-FT		7.	9.	11.	11.	
HOUS CU M		4.	11.	11.	11.	

HYDROGRAPH AT STATION 0001 FOR PLAN 1. RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
LF5	86.	20.	6.	0.	1727.
CM5	2.	1.	0.	0.	47.
INCH5		27.60	3.19	3.17	3.12
—HM		67.47	80.26	80.96	80.46
AC-11		12.	12.	12.	12.
HOUS. CH. M		12.	12.	12.	12.

XXXXXXXXXX OF SI000000 CAN BE AN , MYTO A

CFS
 CFS
 INCHLS
 AC-FT
 THOUS CU M

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
108.	25.	7.	0.	2157.
3.	1.	0.	0.	376.
	3.32	1.78	0.37	10.15
	64.33	101.19	101.19	12.
	15.	18.	18.	18.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

CFS
 CFS
 INCHLS
 AC-FT
 THOUS CU M

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
130.	30.	9.	0.	2590.
4.	1.	0.	0.	73.
	3.32	1.78	0.37	10.15
	64.33	101.19	101.19	12.
	15.	18.	18.	18.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6

CFS
 CFS
 INCHLS
 AC-FT
 THOUS CU M

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
173.	40.	12.	0.	3454.
5.	1.	0.	0.	98.
	3.32	1.78	0.37	10.15
	64.33	101.19	101.19	12.
	15.	18.	18.	18.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

CFS
 CFS
 INCHLS
 AC-FT
 THOUS CU M

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
216.	50.	15.	0.	4317.
6.	1.	0.	0.	122.
	3.32	1.78	0.37	10.15
	64.33	101.19	101.19	12.
	15.	18.	18.	18.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8

CFS
 CFS
 INCHLS
 AC-FT
 THOUS CU M

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
432.	100.	30.	0.	8634.
12.	1.	0.	0.	244.
	3.32	1.78	0.37	10.15
	64.33	101.19	101.19	12.
	15.	18.	18.	18.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 9

CFS
 CFS
 INCHLS
 AC-FT
 THOUS CU M

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
865.	200.	60.	0.	17289.
24.	1.	0.	0.	244.
	3.32	1.78	0.37	10.15
	64.33	101.19	101.19	12.
	15.	18.	18.	18.

HYDROGRAPH ROUTING									
ROUTED FLOWS THROUGH THE NORTH DAM									
STAGE	ICOMP	ALCON	ITAPE	JPL1	JPL2	JPLT	INAME	ISTAGE	IAUTO
000002	1	0	0	0	0	0	0	0	0
GLOSS	CROSS	AVG	ROUTING DATA	IPMP	IPMP	IPMP	IPMP	IPMP	IPMP
0.0	0.000	0.00	ISAME	1	0	0	0	0	0
INSTPS	INSTOL	LAG	AMSKK	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0
STAGE	489.00	489.00	489.50	489.00	489.00	489.50	490.00	490.00	491.00
	487.50	487.50	489.50	489.00	489.00	489.50	490.00	490.00	491.50

• PIANO

REBIN VAN FALLING AT 15.92 HOURS

STATION 00002, PLAN 1, RATIO 3 010 PMF

END-OF-PERIOD HYDROGRAPH ORIGINATES

UNIT FLOW

STORAGE

[illegible]

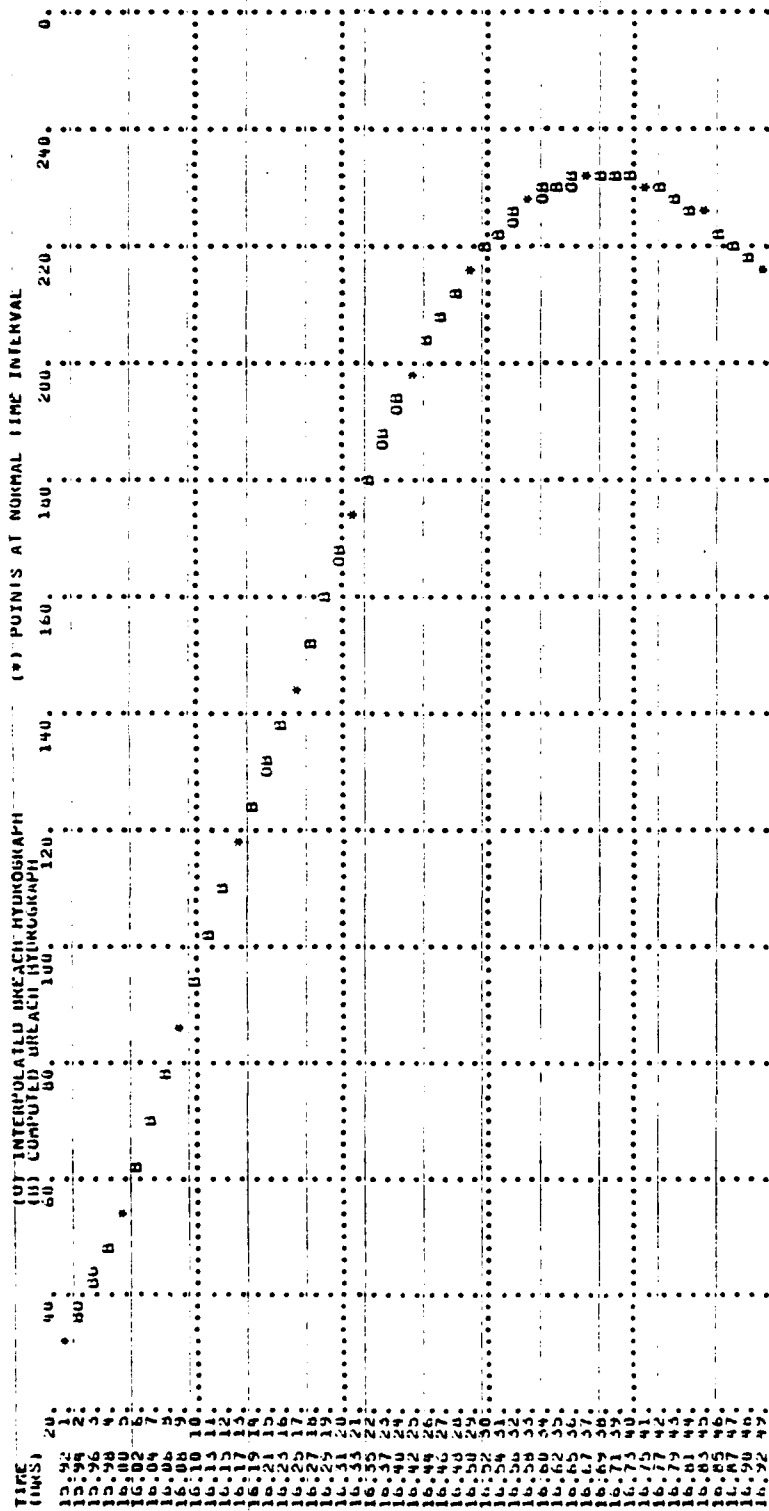
PEAK WIDTH IS 232. AT TIME 16.69 HOURS

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION. DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .003 HOURS. THIS TABLE COMPARES THE HYDROGRAPH FOR INTERPOLATED VALUES WITH THE COMPUTED BREACH HYDROGRAPH. INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

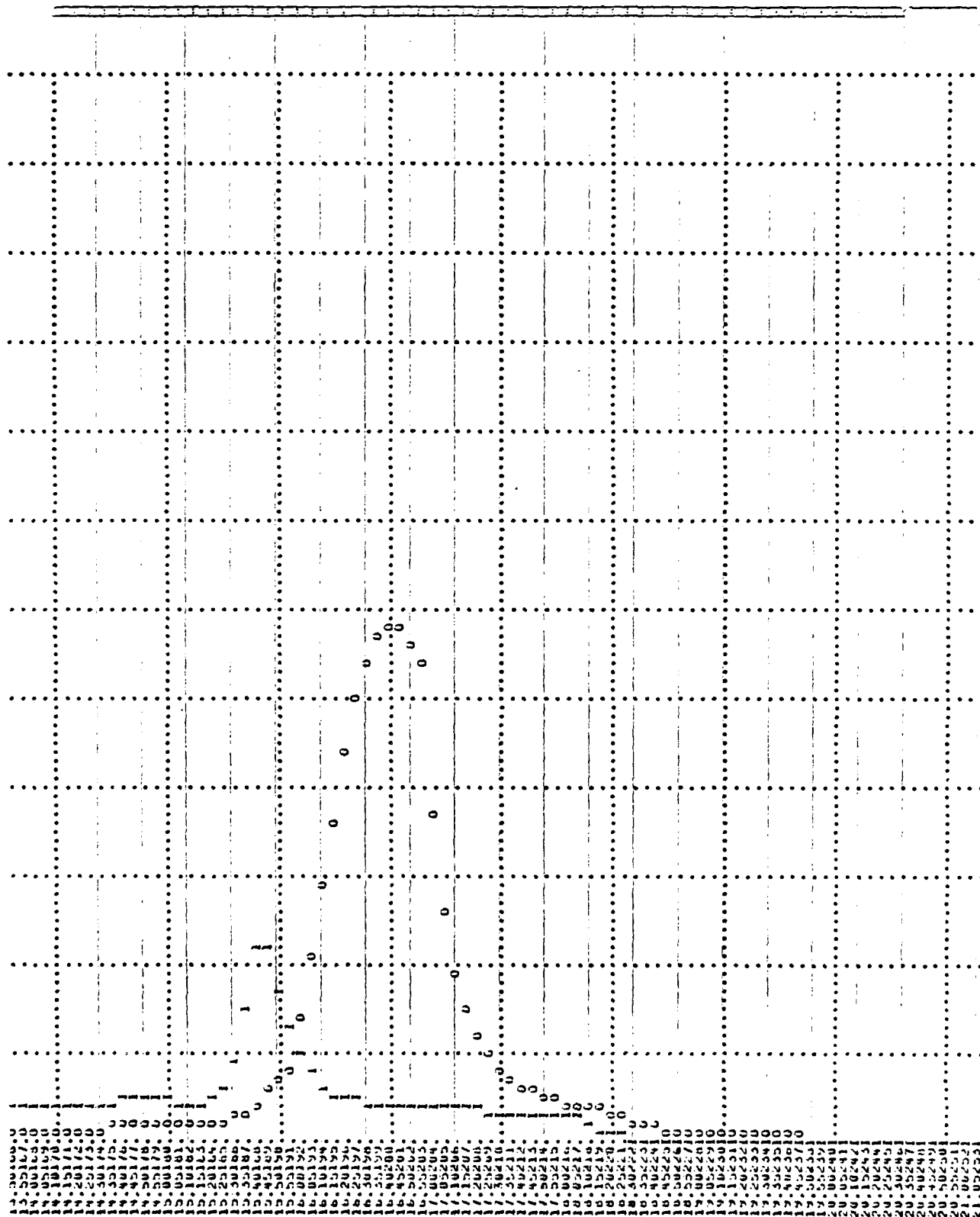
TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	COMPUTED BREACH HYDROGRAPH (CFS)	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
15.917	0.000	52.	52.	0.	0.	0.
15.938	.021	50.	56.	2.	2.	0.
15.958	.042	49.	41.	2.	4.	0.
15.979	.063	49.	40.	1.	5.	0.
16.000	.083	54.	54.	0.	5.	0.
16.021	.104	62.	62.	0.	6.	0.
16.042	.125	70.	77.	7.	13.	0.
16.063	.145	78.	97.	19.	32.	0.
16.083	.167	85.	85.	0.	32.	0.
16.103	.188	93.	94.	1.	33.	0.
16.125	.208	101.	102.	1.	34.	0.
16.145	.229	109.	109.	0.	34.	0.
16.167	.250	117.	117.	0.	34.	0.
16.188	.271	124.	124.	0.	34.	0.
16.208	.292	131.	132.	1.	35.	0.
16.229	.313	138.	138.	0.	35.	0.
16.250	.333	145.	145.	0.	35.	0.
16.271	.354	152.	153.	1.	36.	0.
16.292	.375	160.	160.	0.	36.	0.
16.313	.396	167.	168.	1.	37.	0.
16.333	.417	174.	174.	0.	37.	0.
16.354	.438	180.	181.	1.	38.	0.
16.375	.459	187.	187.	0.	38.	0.
16.396	.479	193.	193.	0.	38.	0.
16.417	.500	199.	199.	0.	38.	0.
16.438	.521	203.	204.	1.	39.	0.
16.458	.542	208.	209.	1.	40.	0.
16.479	.562	212.	213.	1.	41.	0.
16.500	.583	217.	217.	0.	41.	0.
16.521	.604	222.	220.	2.	43.	0.
16.542	.625	227.	223.	4.	47.	0.
16.563	.646	232.	225.	7.	54.	0.
16.583	.667	237.	229.	8.	62.	0.
16.604	.687	242.	231.	11.	73.	0.
16.625	.708	247.	233.	14.	87.	0.
16.646	.729	252.	235.	17.	104.	0.
16.668	.750	257.	237.	20.	124.	0.
16.688	.771	262.	239.	23.	147.	0.
16.709	.792	267.	241.	26.	173.	0.
16.729	.813	272.	243.	29.	202.	0.
16.750	.834	277.	245.	32.	234.	0.
16.771	.854	282.	247.	35.	269.	0.
16.792	.875	287.	249.	38.	307.	0.
16.813	.896	292.	251.	41.	348.	0.
16.833	.917	297.	253.	44.	392.	0.
16.854	.937	302.	255.	47.	439.	0.
16.875	.958	307.	257.	50.	489.	0.
16.896	.979	312.	259.	53.	542.	0.
16.917	1.000	316.	261.	55.	597.	0.

STATION 0000002

UVF *



6.40 601
6.45 611
6.50 621
6.55 631
7.00 641
7.05 651
7.10 661
7.15 671
7.20 681
7.25 691
7.30 701
7.35 711
7.40 721
7.45 731
7.50 741
7.55 751
8.00 761
8.05 771
8.10 781
8.15 791
8.20 801
8.25 811
8.30 821
8.35 831
8.40 841
8.45 851
8.50 861
8.55 871
9.00 881
9.05 891
9.10 901
9.15 911
9.20 921
9.25 931
9.30 941
9.35 951
9.40 961
9.45 971
9.50 981
9.55 991
10.00 1001
10.05 1011
10.10 1021
10.15 1031
10.20 1041
10.25 1051
10.30 1061
10.35 1071
10.40 1081
10.45 1091
10.50 1101
10.55 1111
11.00 1121
11.05 1131
11.10 1141
11.15 1151
11.20 1161
11.25 1171
11.30 1181
11.35 1191
11.40 1201
11.45 1211
11.50 1221
11.55 1231
12.00 1241
12.05 1251
12.10 1261
12.15 1271
12.20 1281
12.25 1291
12.30 1301
12.35 1311
12.40 1321
12.45 1331
12.50 1341
12.55 1351
13.00 1361
13.05 1371
13.10 1381
13.15 1391
13.20 1401
13.25 1411
13.30 1421
13.35 1431
13.40 1441
13.45 1451
13.50 1461
13.55 1471
14.00 1481
14.05 1491
14.10 1501
14.15 1511
14.20 1521
14.25 1531
14.30 1541
14.35 1551
14.40 1561
14.45 1571
14.50 1581
14.55 1591
15.00 1601
15.05 1611
15.10 1621
15.15 1631
15.20 1641
15.25 1651
15.30 1661
15.35 1671
15.40 1681
15.45 1691
15.50 1701
15.55 1711
16.00 1721
16.05 1731
16.10 1741
16.15 1751
16.20 1761
16.25 1771
16.30 1781
16.35 1791
16.40 1801
16.45 1811
16.50 1821
16.55 1831
17.00 1841
17.05 1851
17.10 1861
17.15 1871
17.20 1881
17.25 1891
17.30 1901
17.35 1911
17.40 1921
17.45 1931
17.50 1941
17.55 1951
18.00 1961
18.05 1971
18.10 1981
18.15 1991
18.20 2001
18.25 2011
18.30 2021
18.35 2031
18.40 2041
18.45 2051
18.50 2061
18.55 2071
19.00 2081
19.05 2091
19.10 2101
19.15 2111
19.20 2121
19.25 2131
19.30 2141
19.35 2151
19.40 2161
19.45 2171
19.50 2181
19.55 2191
20.00 2201
20.05 2211
20.10 2221
20.15 2231
20.20 2241
20.25 2251
20.30 2261
20.35 2271
20.40 2281
20.45 2291
20.50 2301
20.55 2311
21.00 2321
21.05 2331
21.10 2341
21.15 2351
21.20 2361
21.25 2371
21.30 2381
21.35 2391
21.40 2401
21.45 2411
21.50 2421
21.55 2431
22.00 2441
22.05 2451
22.10 2461
22.15 2471
22.20 2481
22.25 2491
22.30 2501
22.35 2511
22.40 2521
22.45 2531
22.50 2541
22.55 2551
23.00 2561
23.05 2571
23.10 2581
23.15 2591
23.20 2601
23.25 2611
23.30 2621
23.35 2631
23.40 2641
23.45 2651
23.50 2661
23.55 2671
24.00 2681
24.05 2691
24.10 2701
24.15 2711
24.20 2721
24.25 2731
24.30 2741
24.35 2751
24.40 2761
24.45 2771
24.50 2781
24.55 2791
25.00 2801
25.05 2811
25.10 2821
25.15 2831
25.20 2841
25.25 2851
25.30 2861
25.35 2871
25.40 2881
25.45 2891
25.50 2901
25.55 2911
26.00 2921
26.05 2931
26.10 2941
26.15 2951
26.20 2961
26.25 2971
26.30 2981
26.35 2991
26.40 3001
26.45 3011
26.50 3021
26.55 3031
27.00 3041
27.05 3051
27.10 3061
27.15 3071
27.20 3081
27.25 3091
27.30 3101
27.35 3111
27.40 3121
27.45 3131
27.50 3141
27.55 3151
28.00 3161
28.05 3171
28.10 3181
28.15 3191
28.20 3201
28.25 3211
28.30 3221
28.35 3231
28.40 3241
28.45 3251
28.50 3261
28.55 3271
29.00 3281
29.05 3291
29.10 3301
29.15 3311
29.20 3321
29.25 3331
29.30 3341
29.35 3351
29.40 3361
29.45 3371
29.50 3381
29.55 3391
30.00 3401
30.05 3411
30.10 3421
30.15 3431
30.20 3441
30.25 3451
30.30 3461
30.35 3471
30.40 3481
30.45 3491
30.50 3501
30.55 3511
31.00 3521
31.05 3531
31.10 3541
31.15 3551
31.20 3561
31.25 3571
31.30 3581
31.35 3591
31.40 3601
31.45 3611
31.50 3621
31.55 3631
32.00 3641
32.05 3651
32.10 3661
32.15 3671
32.20 3681
32.25 3691
32.30 3701
32.35 3711
32.40 3721
32.45 3731
32.50 3741
32.55 3751
33.00 3761
33.05 3771
33.10 3781
33.15 3791
33.20 3801
33.25 3811
33.30 3821
33.35 3831
33.40 3841
33.45 3851
33.50 3861
33.55 3871
34.00 3881
34.05 3891
34.10 3901
34.15 3911
34.20 3921
34.25 3931
34.30 3941
34.35 3951
34.40 3961
34.45 3971
34.50 3981
34.55 3991
35.00 4001
35.05 4011
35.10 4021
35.15 4031
35.20 4041
35.25 4051
35.30 4061
35.35 4071
35.40 4081
35.45 4091
35.50 4101
35.55 4111
36.00 4121
36.05 4131
36.10 4141
36.15 4151
36.20 4161
36.25 4171
36.30 4181
36.35 4191
36.40 4201
36.45 4211
36.50 4221
36.55 4231
37.00 4241
37.05 4251
37.10 4261
37.15 4271
37.20 4281
37.25 4291
37.30 4301
37.35 4311
37.40 4321
37.45 4331
37.50 4341
37.55 4351
38.00 4361
38.05 4371
38.10 4381
38.15 4391
38.20 4401
38.25 4411
38.30 4421
38.35 4431
38.40 4441
38.45 4451
38.50 4461
38.55 4471
39.00 4481
39.05 4491
39.10 4501
39.15 4511
39.20 4521
39.25 4531
39.30 4541
39.35 4551
39.40 4561
39.45 4571
39.50 4581
39.55 4591
40.00 4601
40.05 4611
40.10 4621
40.15 4631
40.20 4641
40.25 4651
40.30 4661
40.35 4671
40.40 4681
40.45 4691
40.50 4701
40.55 4711
41.00 4721
41.05 4731
41.10 4741
41.15 4751
41.20 4761
41.25 4771
41.30 4781
41.35 4791
41.40 4801
41.45 4811
41.50 4821
41.55 4831
42.00 4841
42.05 4851
42.10 4861
42.15 4871
42.20 4881
42.25 4891
42.30 4901
42.35 4911
42.40 4921
42.45 4931
42.50 4941
42.55 4951
43.00 4961
43.05 4971
43.10 4981
43.15 4991
43.20 5001
43.25 5011
43.30 5021
43.35 5031
43.40 5041
43.45 5051
43.50 5061
43.55 5071
44.00 5081
44.05 5091
44.10 5101
44.15 5111
44.20 5121
44.25 5131
44.30 5141
44.35 5151
44.40 5161
44.45 5171
44.50 5181
44.55 5191
45.00 5201
45.05 5211
45.10 5221
45.15 5231
45.20 5241
45.25 5251
45.30 5261
45.35 5271
45.40 5281
45.45 5291
45.50 5301
45.55 5311
46.00 5321
46.05 5331
46.10 5341
46.15 5351
46.20 5361
46.25 5371
46.30 5381
46.35 5391
46.40 5401
46.45 5411
46.50 5421
46.55 5431
47.00 5441
47.05 5451
47.10 5461
47.15 5471
47.20 5481
47.25 5491
47.30 5501
47.35 5511
47.40 5521
47.45 5531
47.50 5541
47.55 5551
48.00 5561
48.05 5571
48.10 5581
48.15 5591
48.20 5601
48.25 5611
48.30 5621
48.35 5631
48.40 5641
48.45 5651
48.50 5661
48.55 5671
49.00 5681
49.05 5691
49.10 5701
49.15 5711
49.20 5721
49.25 5731
49.30 5741
49.35 5751
49.40 5761
49.45 5771
49.50 5781
49.55 5791
50.00 5801
50.05 5811
50.10 5821
50.15 5831
50.20 5841
50.25 5851
50.30 5861
50.35 5871
50.40 5881
50.45 5891
50.50 5901
50.55 5911
51.00 5921
51.05 5931
51.10 5941
51.15 5951
51.20 5961
51.25 5971
51.30 5981
51.35 5991
51.40 6001
51.45 6011
51.50 6021
51.55 6031
52.00 6041
52.05 6051
52.10 6061
52.15 6071
52.20 6081
52.25 6091
52.30 6101
52.35 6111
52.40 6121
52.45 6131
52.50 6141
52.55 6151
53.00 6161
53.05 6171
53.10 6181
53.15 6191
53.20 6201
53.25 6211
53.30 6221
53.35 6231
53.40 6241
53.45 6251
53.50 6261
53.55 6271
54.00 6281
54.05 6291
54.10 6301
54.15 6311
54.20 6321
54.25 6331
54.30 6341
54.35 6351
54.40 6361
54.45 6371
54.50 6381
54.55 6391
55.00 6401
55.05 6411
55.10 6421
55.15 6431
55.20 6441
55.25 6451
55.30 6461
55.35 6471
55.40 6481
55.45 6491
55.50 6501
55.55 6511
56.00 6521
56.05 6531
56.10 6541
56.15 6551
56.20 6561
56.25 6571
56.30 6581
56.35 6591
56.40 6601
56.45 6611
56.50 6621
56.55 6631
57.00 6641
57.05 6651
57.10 6661
57.15 6671
57.20 6681
57.25 6691
57.30 6701
57.35 6711
57.40 6721
57.45 6731
57.50 6741
57.55 6751
58.00 6761
58.05 6771
58.10 6781
58.15 6791
58.20 6801
58.25 6811
58.30 6821
58.35 6831
58.40 6841
58.45 6851
58.50 6861
58.55 6871
59.00 6881
59.05 6891
59.10 6901
59.15 6911
59.20 6921
59.25 6931
59.30 6941
59.35 6951
59.40 6961
59.45 6971
59.50 6981
59.55 6991
60.00 7001
60.05 7011
60.10 7021
60.15 7031
60.20 7041
60.25 7051
60.30 7061
60.35 7071
60.40 7081
60.45 7091
60.50 7101
60.55 7111
61.00 7121
61.05 7131
61.10 7141
61.15 7151
61.20 7161
61.25 7171
61.30 7181
61.35 7191
61.40 7201
61.45 7211
61.50 7221
61.55 7231
62.00 7241
62.05 7251
62.10 7261
62.15 7271
62.20 7281
62.25 7291
62.30 7301
62.35 7311
62.40 7321
62.45 7331
62.50 7341
62.55 7351
63.00 7361
63.05 7371
63.10 7381
63.15 7391
63.20 7401
63.25 7411
63.30 7421
63.35 7431
63.40 7441
63.45 7451
63.50 7461
63.55 7471
64.00 7481
64.05 7491
64.10 7501
64.15 7511
64.20 7521
64.25 7531
64.30 7541
64.35 7551
64.40 7561
64.45 7571
64.50 7581
64.55 7591
65.00 7601
65.05 7611
65.10 7621
65.15 7631
65.20 7641
65.25 7651
65.30 7661
65.35 7671
65.40 7681
65.45 7691
65.50 7701
65.55 7711
66.00 7721
66.05 7731
66.10 7741
66.15 7751
66.20 7761
66.25 7771
66.30 7781
66.35 7791
66.40 7801
66.45 7811
66.50 7821
66.55 7831
67.00 7841
67.05 7851
67.10 7861
67.15 7871
67.20 7881
67.25 7891
67.30 7901
67.35 7911
67.40 7921
67.45 7931
67.50 7941
67.55 7951
68.00 7961
68.05 7971
68.10 7981
68.15 7991
68.20 8001
68.25 8011
68.30 8021
68.35 8031
68.40 8041
68.45 8051
68.50 8061
68.55 8071
69.00 8081
69.05 8091
69.10 8101
69.15 8111
69.20 8121
69.25 8131
69.30 8141
69.35 8151
69.40 8161
69.45 8171
69.50 8181
69.55 8191
70.00 8201
70.05 8211
70.10 8221
70.15 8231
70.20 8241
70.25 8251
70.30 8261
70.35 8271
70.40 8281
70.45 8291
70.50 8301
70.55 8311
71.00 8321
71.05 8331
71.10 8341
71.15 8351
71.20 8361
71.25 8371
71.30 8381
71.35 8391
71.40 8401
71.45 8411
71.50 8421
71.55 8431
72.00 8441
72.05 8451
72.10 8461
72.15 8471
72.20 8481
72.25 8491
72.30 8501
72.35 8511
72.40 8521
72.45 8531
72.50 8541
72.55 8551
73.00 8561
73.05 8571
73.10 8581
73.15 8591
73.20 8601
73.25 8611
73.30 8621
73.35 8631
73.40 8641
73.45 8651
73.50 8661
73.55 8671
74.00 8681
74.05 8691
74.10 8701
74.15 8711
74.20 8721
74.25 8731
74.30 8741
74.35 8751
74.40 8761
74.45 8771
74.50 8781
74.55 8791
75.00 8801
75.05 8811
75.10 8821
75.15 8831
75.20 8841
75.25 8851
75.30 8861
75.35 8871
75.40 8881
75.45 8891
75.50 8901
75.55 8911
76.00 8921
76.05 8931
76.10 8941
76.15 8951
76.20 8961
76.25 8971
76.30 8981
76.35 8991
76.40 9001
76.45 9011
76.50 9021
76.55 9031
77.00 9041
77.05 9051
77.10 9061
77.15 9071
77.20 9081
77.25 9091
77.30 9101
77.35 9111
77.40 9121
77.45 9131
77.50 9141
77.55 9151
78.00 9161
78.05 9171
78.10 9181
78.15 9191
78.20 9201
78.25 9211
78.30 9221
78.35 9231
78.40 9241
78.45 9251
78.50 9261
78.55 9271
79.00 9281
79.05 9291
79.10 9301
79.15 9311
79.20 9321
79.25 9331
79.30 9341
79.35 9351
79.40 9361
79.45 9371
79.50 9381
79.55 9391
80.00 9401
80.05 9411
80.10 9421
80.15 9431
80.20 9441
80.25 9451
80.30 9461
80.35 9471
80.40 9481
80.45 9491
80.50 9501
80.55 9511
81.00 9521
81.05 9531
81.10 9541
81.15 9551
81.20 9561
81.25 9571
81.30 9581
81.35 9591
81.40 9601
81.45 9611
81.50 9621
81.55 9631
82.00 9641
82.05 9651
82.10 9661
82.15 9671
82.20 9681
82.25 9691
82.30 9701
82.35 9711
82.40 9721
82.45 9731
82.50 9741
82.55 9751
83.00 9761
83.05 9771
83.10 9781
83.15 9791
83.20 9801
83.25 9811
83.30 9821
83.35 9831
83.40 9841
83.45 9851
83.50 9861
83.55 9871
84.00 9881
84.05 9891
84.10 9901
84.15 9911
84.20 9921
84.25 9931
84.30 9941
84.35 9951
84.40 9961
84.45 9971
84.50 9981
84.55 9991
85.00 10001
85.05 10011
85.10 10021
85.15 10031
85.20 10041
85.25 10051
85.30 10061
85.35 10071
85.40 10081
85.45 10091
85.50 10101
85.55 10111
86.00 10121
86.05 10131
86.10 10141
86.15 10151
86.20 10161
86.25 10171
86.30 10181
86.35 10191
86.40 10201
86.45 10211
86.50 10221
86.55 10231
87.00 10241
87.05 10251
87.10 10261
87.15 10271
87.20 10281
87.25 10291
87.30 10301
87.35 10311
87.40 10321
87.45 10331
87.50 10341
87.55 10351
88.00 10361
88.05 10371
88.10 10381
88.15 10391
88.20 10401
88.25 10411
88.30 10421
88.35 10431
88.40 10441
88.45 10451
88.50 10461
88.55 10471
89.00 10481
89.05 10491
89.10 10501
89.15 10511
89.20 10521
89.25 10531
89.30 10541
89.35 10551
89.40 10561
89.45 10571
89.50 10581
89.55 10591
90.00 10601
90.05 10611
90.10 10621
90.15 10631
90.20 10641
90.25 10651
90.30 10661
90.35 10671
90.40 10681
90.45 10691
90.50 10701
90.55 10711
91.00 10721
91.05 10731
91.10 10741
91.15 10751
91.20 10761
91.25 10771
91.30 10781
91.35 10791
91.40 10801
91.45 10811
91.50 10821
91.55 10831
92.00 10841
92.05 10851



[illegible]

STATION 000002, PLAN 1, RATIO 6 0.5 PMF

END-OF-PERIOD HYDROGRAPH UTILITIES

תקנה 41א

[illegible]

STORAGE

[illegible]

STAGE

[illegible]

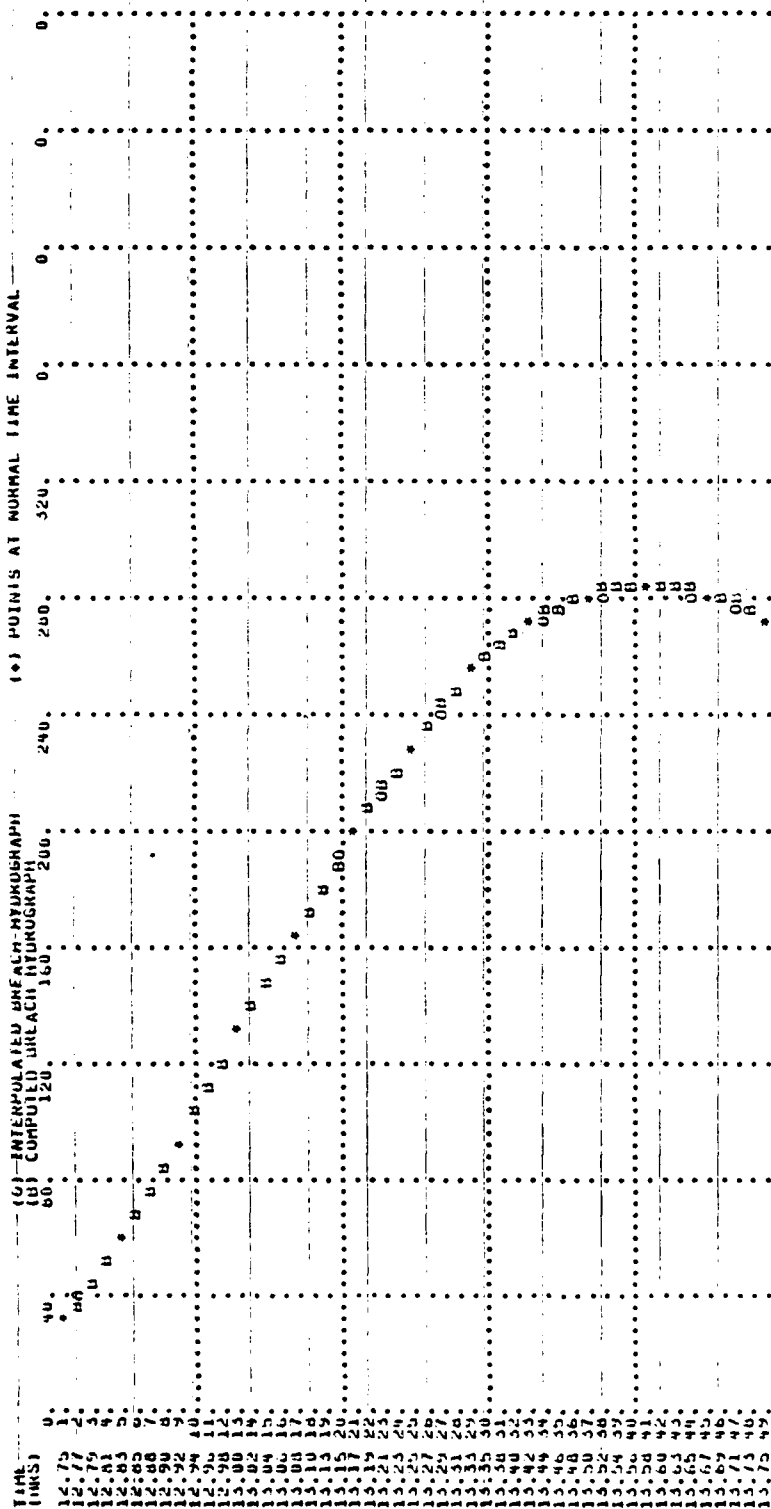
[illegible]

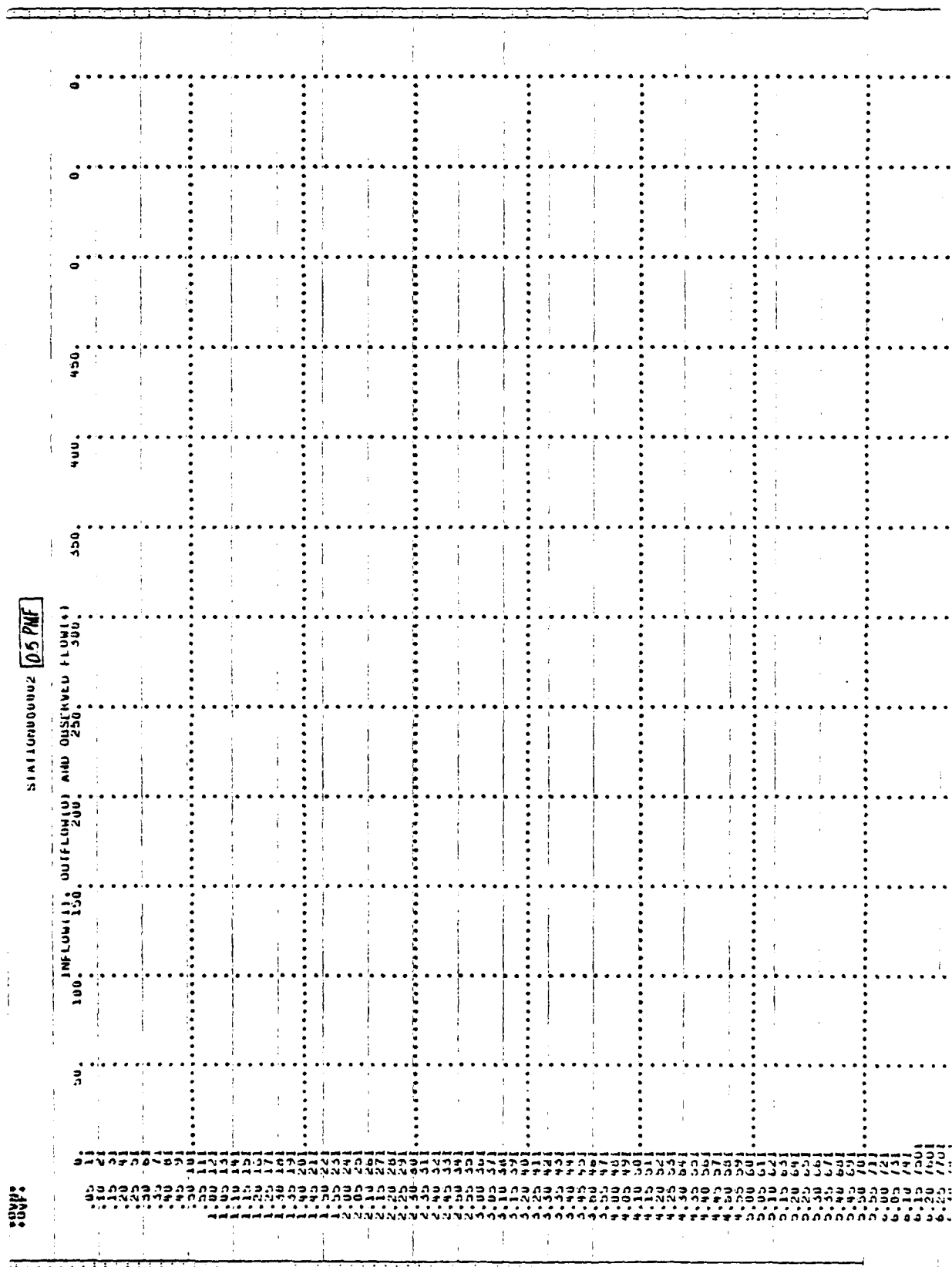
THE DATA AND HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .021 HOURS DURING BREACH FORMATION.
 THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
 INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

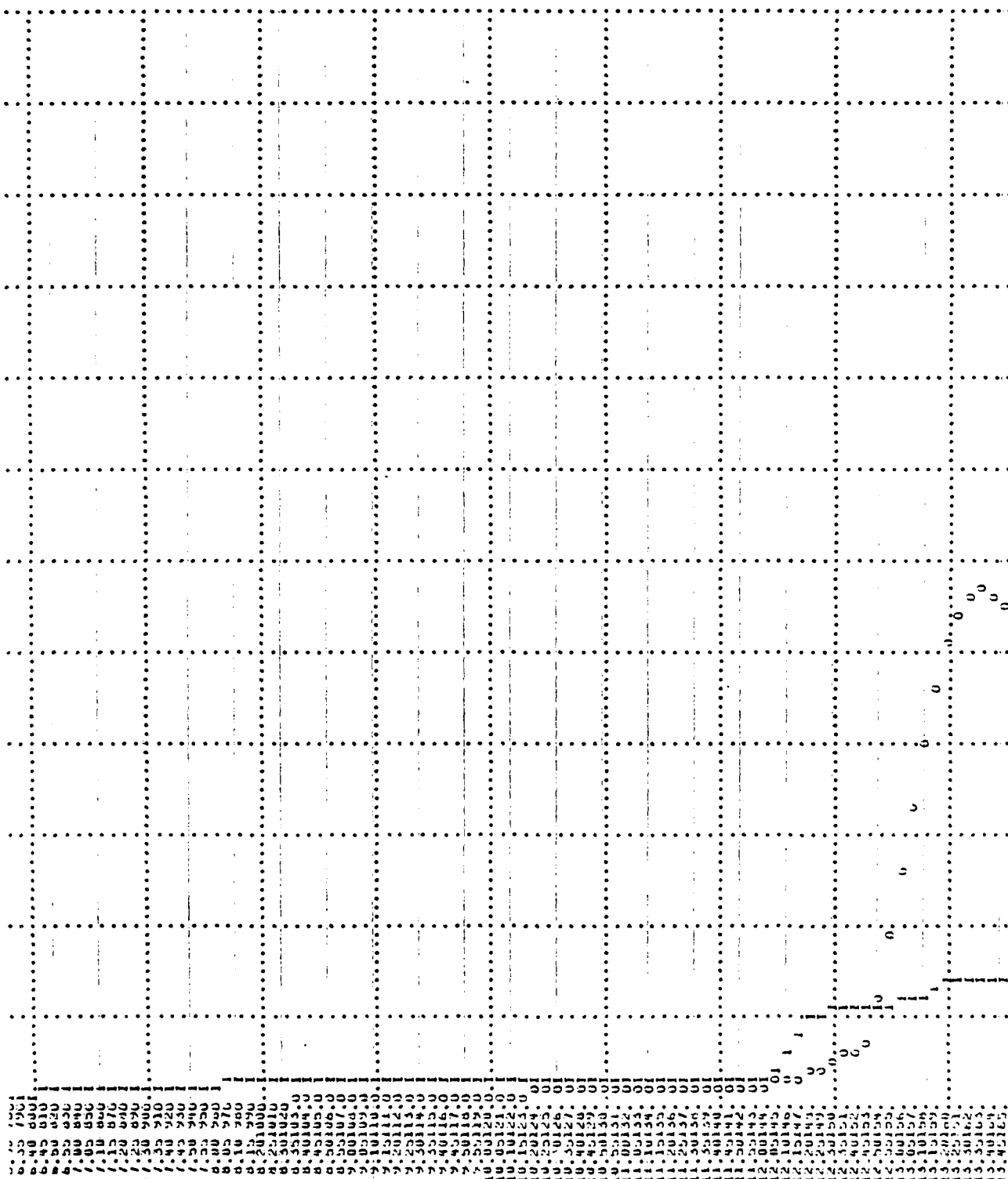
TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	COMPUTED BREACH HYDROGRAPH (CFS)	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
12.750	0.000	32	32	0	0	0
12.771	.021	30	31	-1	-1	0
12.792	.042	28	29	-1	-2	0
12.813	.063	26	27	-1	-3	0
12.834	.084	24	25	-1	-4	0
12.855	.105	22	23	-1	-5	0
12.876	.125	20	21	-1	-6	0
12.897	.146	18	19	-1	-7	0
12.918	.167	16	17	-1	-8	0
12.939	.188	14	15	-1	-9	0
12.960	.209	12	13	-1	-10	0
12.981	.229	10	11	-1	-11	0
13.000	.250	8	9	-1	-12	0
13.021	.271	6	7	-1	-13	0
13.042	.292	4	5	-1	-14	0
13.063	.313	2	3	-1	-15	0
13.084	.334	0	1	-1	-16	0
13.105	.355	0	0	0	-16	0
13.126	.375	0	0	0	-16	0
13.147	.396	0	0	0	-16	0
13.168	.417	0	0	0	-16	0
13.189	.437	0	0	0	-16	0
13.210	.458	0	0	0	-16	0
13.231	.479	0	0	0	-16	0
13.252	.500	0	0	0	-16	0
13.273	.521	0	0	0	-16	0
13.294	.542	0	0	0	-16	0
13.315	.563	0	0	0	-16	0
13.336	.584	0	0	0	-16	0
13.357	.605	0	0	0	-16	0
13.378	.626	0	0	0	-16	0
13.399	.647	0	0	0	-16	0
13.420	.667	0	0	0	-16	0
13.441	.688	0	0	0	-16	0
13.462	.709	0	0	0	-16	0
13.483	.729	0	0	0	-16	0
13.504	.750	0	0	0	-16	0
13.525	.771	0	0	0	-16	0
13.546	.792	0	0	0	-16	0
13.567	.813	0	0	0	-16	0
13.588	.834	0	0	0	-16	0
13.609	.855	0	0	0	-16	0
13.630	.876	0	0	0	-16	0
13.651	.897	0	0	0	-16	0
13.672	.917	0	0	0	-16	0
13.693	.938	0	0	0	-16	0
13.714	.959	0	0	0	-16	0
13.735	.979	0	0	0	-16	0
13.750	1.000	0	0	0	-16	0

STATION 0000002

0000







AD-A105 294

HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE
NATIONAL DAM SAFETY PROGRAM. LAKE TANGLEWOOD SOUTH DAM (NO 3122--ETC(U)
OCT 80 R S DECKER, G JAMISON, G ULMER

F/G 13/13

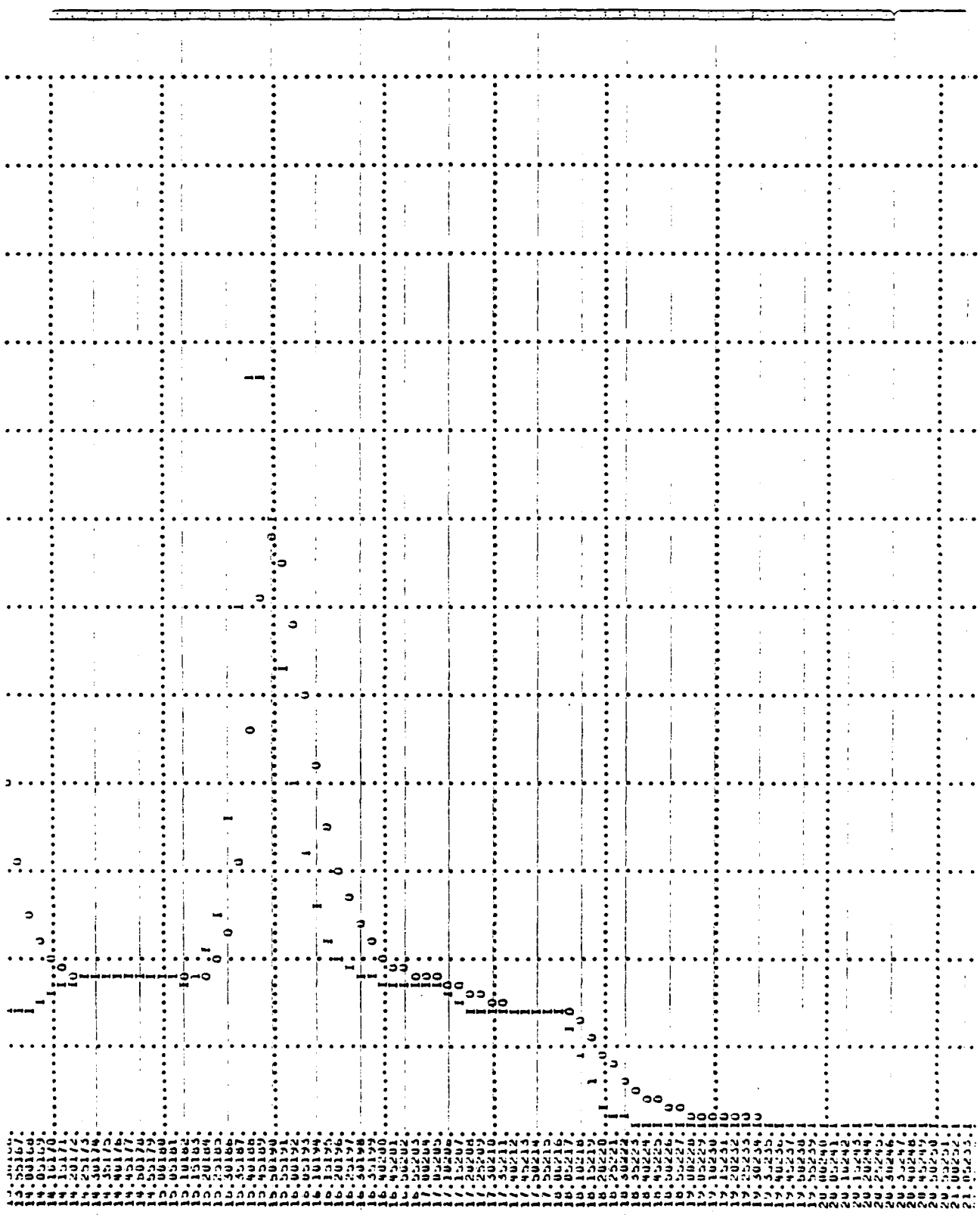
DACW43-81-C-0003

NL

UNCLASSIFIED

2 OF 2
AD A
10-81

END
DATE
FILMED
10-81
DTIC



[illegible]

• **Plan** •

STATION 000002, PLAN 1, RATIO 1

STRESSOR FAILURE AT 11.42-HOURS

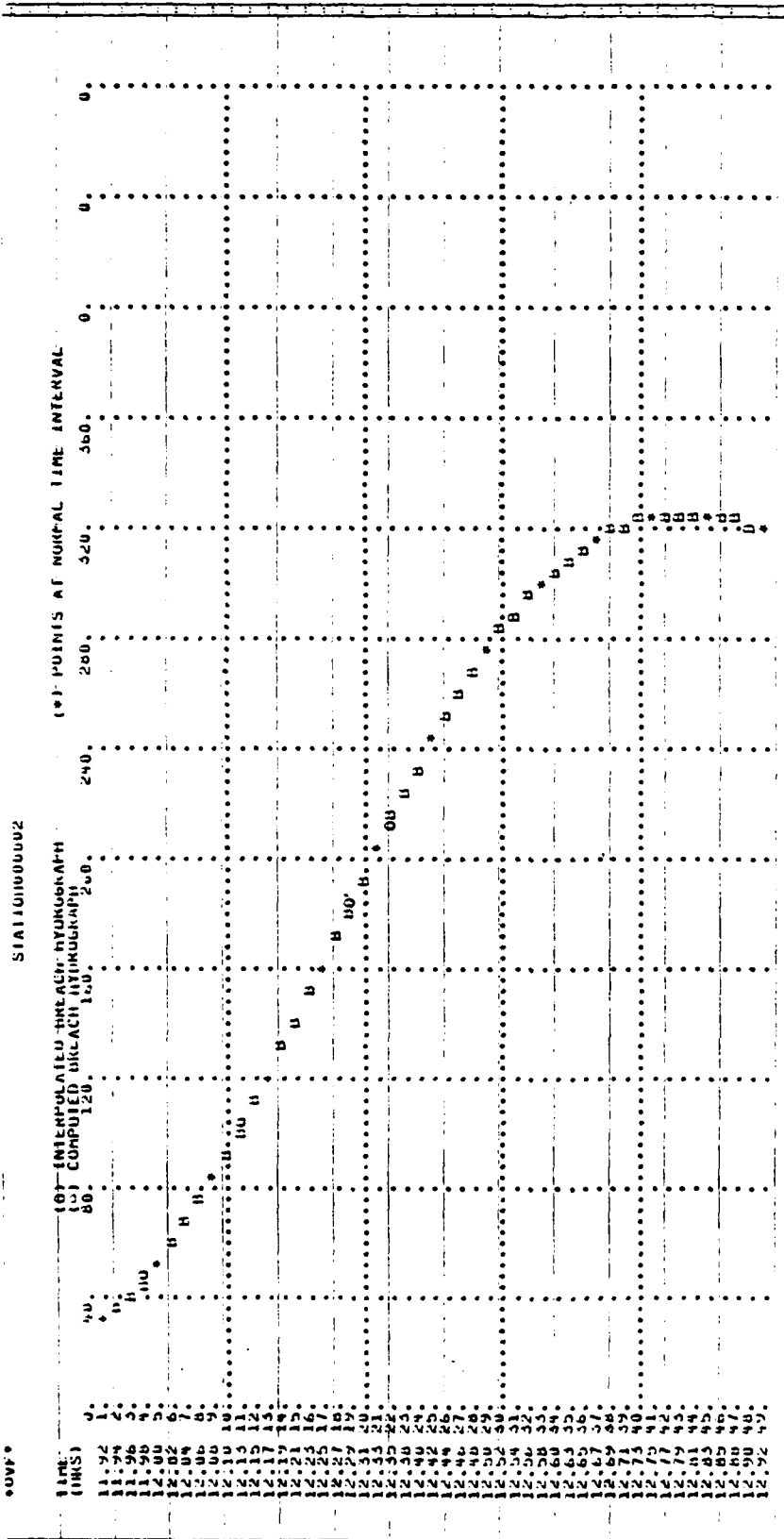
PERIOL-HYDROGRAPH URINALS

[illegible]

PLATE D-30

THE RAC RIVER ASR HYDROGRAPH HAS BEEN DEVELOPED USING A TIME INTERVAL OF .002 HOURS DURING BREACH FORMATION. THIS TIME COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH. INTERPOLATED FLOODS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

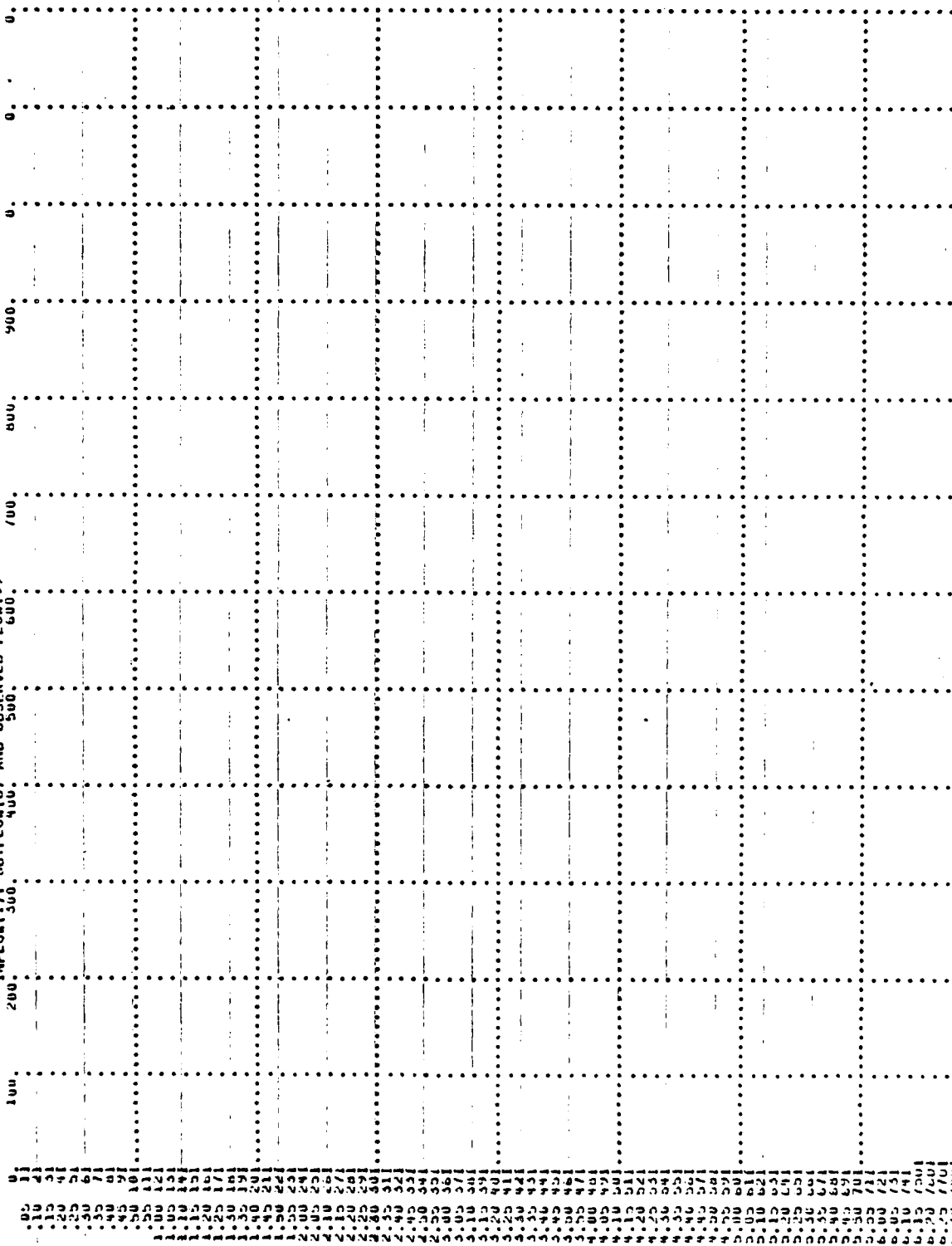
TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	COMPUTED BREACH HYDROGRAPH (CFS)	ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AG-FT)
11.917	0.000	32.	32.	0.	0.	0.
11.938	.021	37.	37.	0.	0.	0.
11.958	.042	42.	42.	0.	0.	0.
11.979	.063	47.	47.	0.	0.	0.
12.000	.084	52.	52.	0.	0.	0.
12.021	.104	57.	57.	0.	0.	0.
12.042	.125	62.	62.	0.	0.	0.
12.063	.146	67.	67.	0.	0.	0.
12.084	.167	72.	72.	0.	0.	0.
12.104	.188	77.	77.	0.	0.	0.
12.125	.208	82.	82.	0.	0.	0.
12.146	.229	87.	87.	0.	0.	0.
12.167	.250	92.	92.	0.	0.	0.
12.188	.271	97.	97.	0.	0.	0.
12.208	.292	102.	102.	0.	0.	0.
12.229	.313	107.	107.	0.	0.	0.
12.250	.333	112.	112.	0.	0.	0.
12.271	.354	117.	117.	0.	0.	0.
12.292	.375	122.	122.	0.	0.	0.
12.313	.396	127.	127.	0.	0.	0.
12.334	.417	132.	132.	0.	0.	0.
12.354	.437	137.	137.	0.	0.	0.
12.375	.458	142.	142.	0.	0.	0.
12.396	.479	147.	147.	0.	0.	0.
12.417	.500	152.	152.	0.	0.	0.
12.438	.521	157.	157.	0.	0.	0.
12.458	.542	162.	162.	0.	0.	0.
12.479	.563	167.	167.	0.	0.	0.
12.500	.584	172.	172.	0.	0.	0.
12.521	.604	177.	177.	0.	0.	0.
12.542	.625	182.	182.	0.	0.	0.
12.563	.646	187.	187.	0.	0.	0.
12.584	.667	192.	192.	0.	0.	0.
12.604	.688	197.	197.	0.	0.	0.
12.625	.708	202.	202.	0.	0.	0.
12.646	.729	207.	207.	0.	0.	0.
12.667	.750	212.	212.	0.	0.	0.
12.688	.771	217.	217.	0.	0.	0.
12.708	.792	222.	222.	0.	0.	0.
12.729	.813	227.	227.	0.	0.	0.
12.750	.833	232.	232.	0.	0.	0.
12.771	.854	237.	237.	0.	0.	0.
12.792	.875	242.	242.	0.	0.	0.
12.813	.896	247.	247.	0.	0.	0.
12.834	.917	252.	252.	0.	0.	0.
12.854	.938	257.	257.	0.	0.	0.
12.875	.959	262.	262.	0.	0.	0.
12.896	.980	267.	267.	0.	0.	0.
12.917	1.000	272.	272.	0.	0.	0.

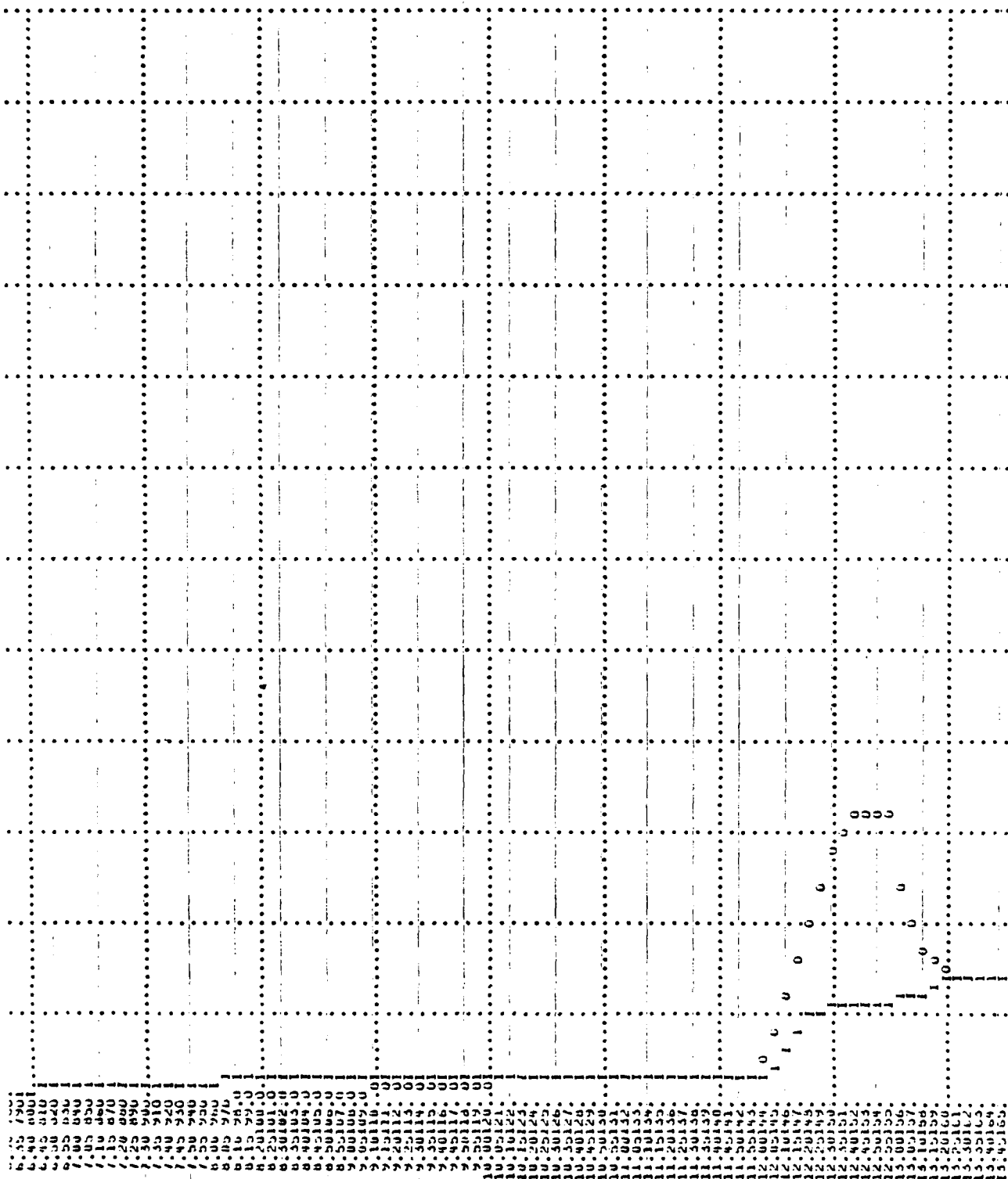


• 1A7 •

PMF

INFLOW (I), OUTFLOW (O) AND OBSERVED FLOW (O)





[illegible]

00000

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO LAKE TANGLEWOOD SOUTH DAM

ISTAD	ICOMP	ILLON	ITAPL	JPLT	JPHI	ITAGL	IAUTO
000003	0	0	0	0	0	0	0

HYDROGRAPH DATA

ISTAD	TAKLA	SHAP	TRSDA	TRSPC	RATIO	ISHOW	ISAME	LOCAL
000003	0.02	0.00	1.00	0.000	0.000	0	1	0

PRECIP DATA

PRECIP	DATA	MM	IN	MM	IN
27.00	102.00	121.00	130.00	0.00	0.00

LOSS DATA

LOSS	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

CURVE NO = -83.00

CURVE	NO	WETNESS	EFFCT	LN
-83.00	0	0.00	0.00	0.00

UNIT HYDROGRAPH DATA

UNIT	HYDROGRAPH	DATA	MM	IN	MM	IN
0.00	0.00	0.00	0.00	0.00	0.00	0.00

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

CFS 35. 13. 4. 4. 4. 1114.
 CFS 2. 0. 0. 0. 0. 32.
 INCHLS 5.37 6.54 6.54 6.54 6.54
 MM 146.40 166.12 166.12 166.12 166.12
 AC-FT 8. 8. 8. 8. 8. 9.
 THOUS CU M 8. 8. 8. 8. 8. 9.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 1

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 68. 16. 5. 5. 1352.
 CFS 2. 0. 0. 0. 39.
 INCHLS 6.72 8.17 8.17 8.17 8.17
 MM 170.61 207.64 207.64 207.64 207.64
 AC-FT 8. 10. 10. 10. 10.
 THOUS CU M 10. 12. 12. 12. 12.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 8

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 157. 32. 10. 10. 2784.
 CFS 4. 13.43 16.55 16.55 16.55
 INCHLS 381.21 415.29 415.29 415.29 415.29
 MM 19. 19. 19. 19. 19.
 AC-FT 19. 24. 24. 24. 24.
 THOUS CU M 19. 24. 24. 24. 24.

HYDROGRAPH AT STA000003 FOR PLAN 1, RTIO 9

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 273. 61. 19. 19. 5188.
 CFS 8. 26.47 32.70 32.70 32.70
 INCHLS 282.42 336.58 336.58 336.58 336.58
 MM 32. 38. 38. 38. 38.
 AC-FT 32. 47. 47. 47. 47.
 THOUS CU M 32. 47. 47. 47. 47.

COMBINE HYDROGRAPHS

COMBINED INFLOW HYDROGRAPH TO LAKE YANGLEROUND SOUTH DAM

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPR1	ITAME	ISTAGE	IAUTO
M 2+3	2	0	0	2	0	1	0	0

SUM OF 2 HYDROGRAPHS AT M 2+3 PLAN 1 RTIO 1

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 18. 8. 3. 3. 890.
 CFS 1. 0. 0. 0. 25.
 INCHLS 21.45 31.75 31.75 31.75 31.75
 MM 4. 6. 6. 6. 6.
 AC-FT 4. 6. 6. 6. 6.
 THOUS CU M 4. 6. 6. 6. 6.

•UVRH•

SUM OF 2 HYDROGRAPHS AT M 2+3					PLAN 1	K110 5	Q1 PMF			
THOUS CU YD	AC-FY	INCHES	CMS	CFS	PLAN	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOL UPL
					238.	50.	13.	13.	368.	
					7.	1.	0.	0.	107.	
						127.96	157.85	157.85	157.85	
						30.	33.	33.	33.	

STATION 2+5 0.1 PNE

INFLOW (cfs): 120, 160, 200, 240

0.1 PNE

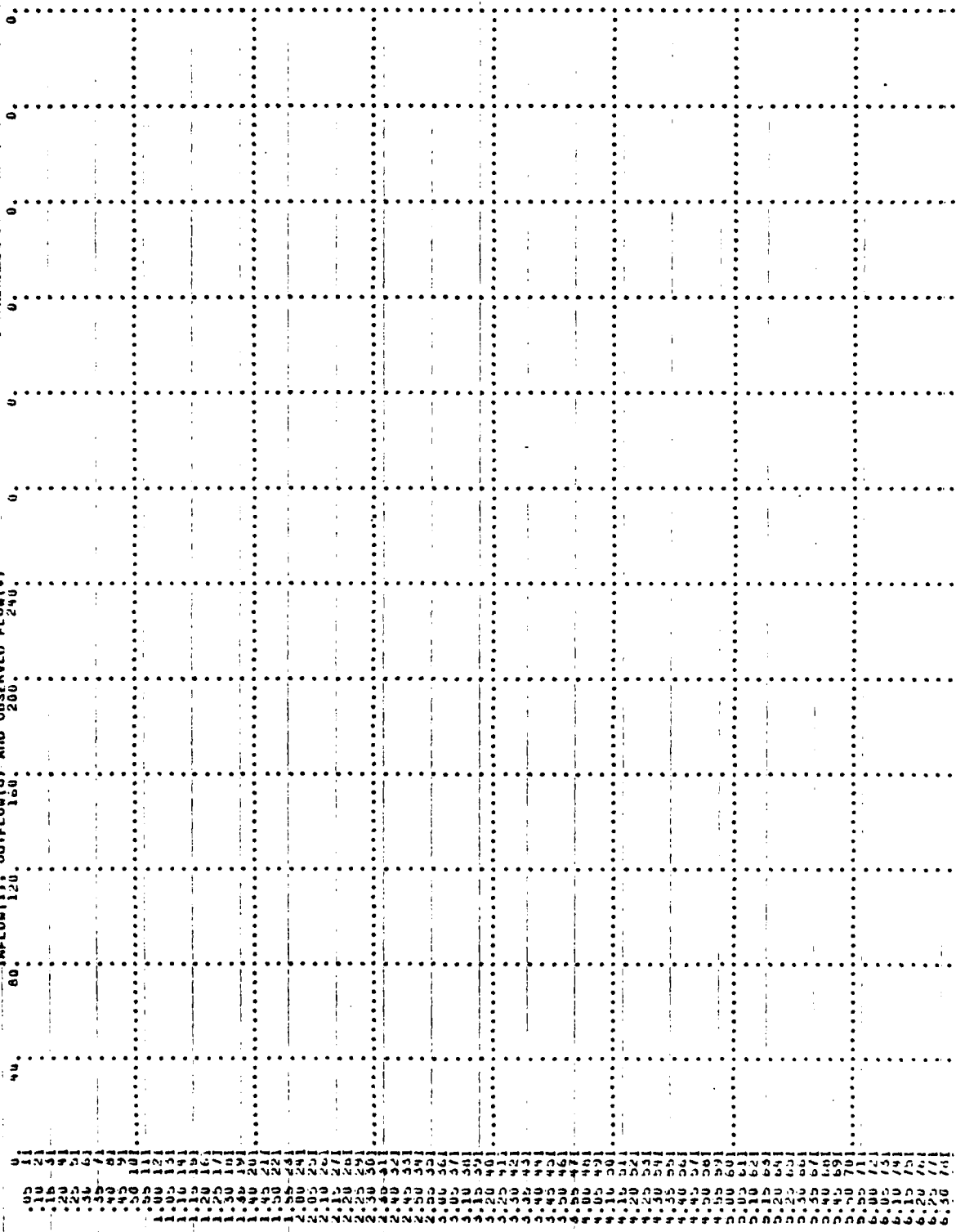
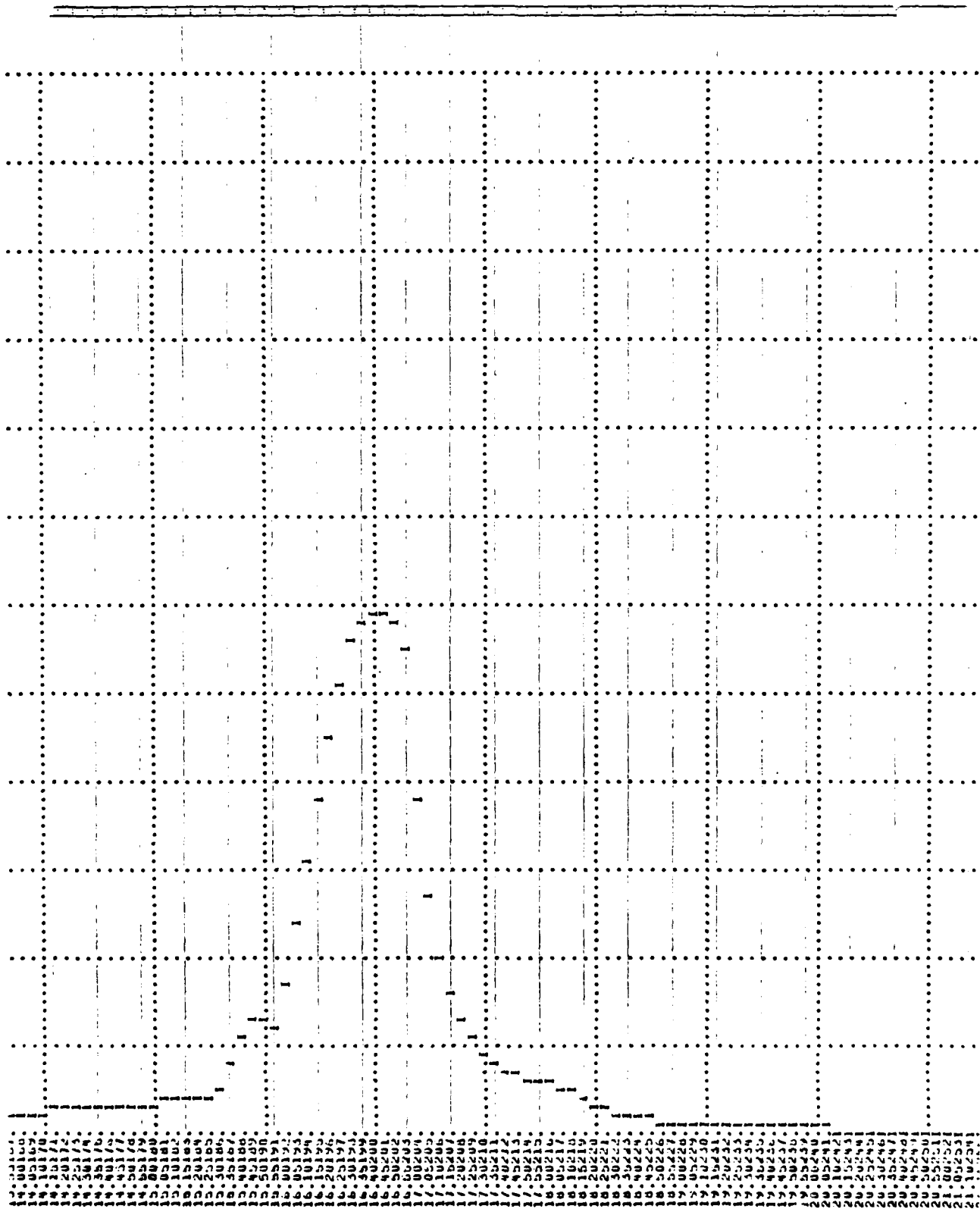


PLATE D-43



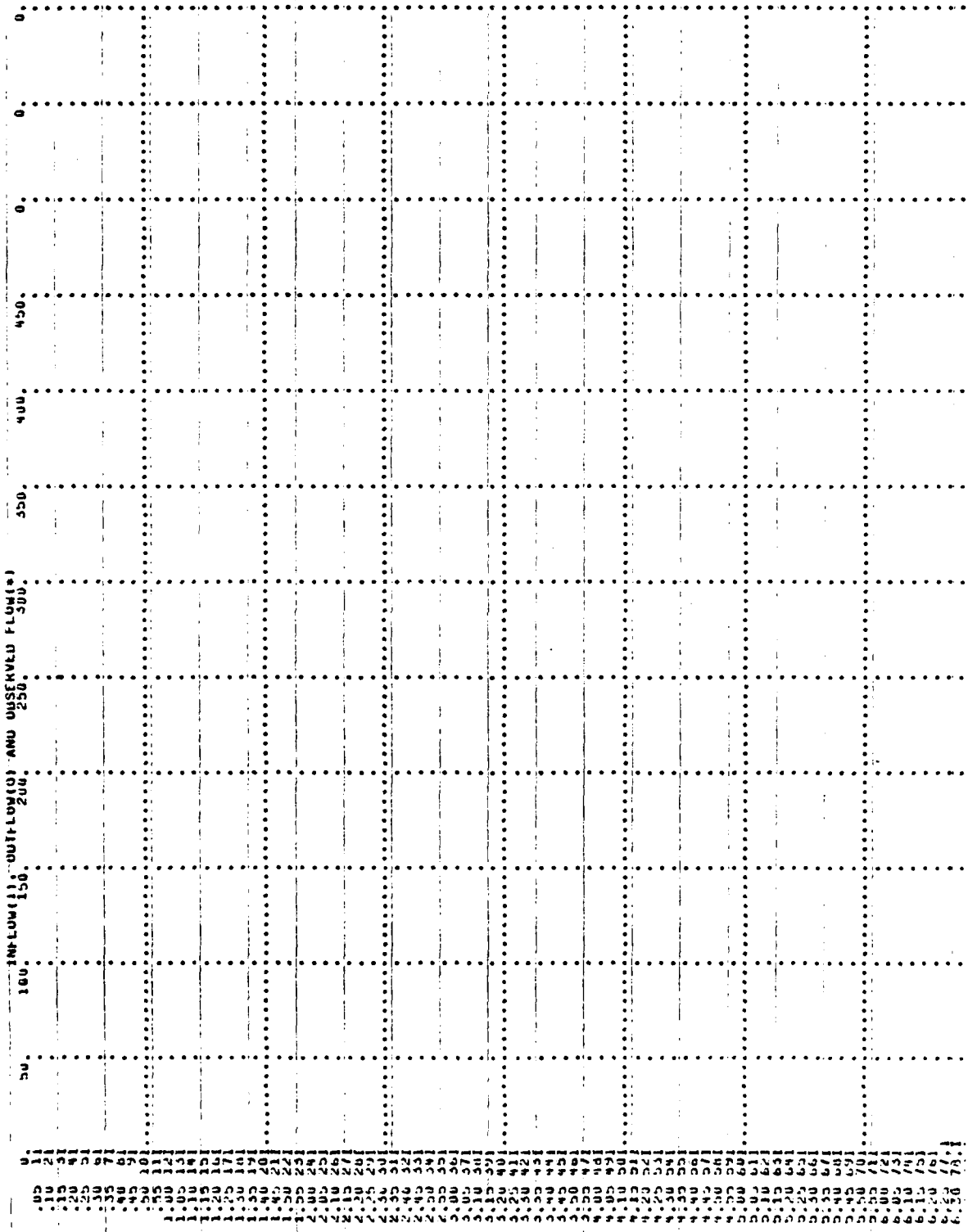
This image shows a full page of dot grid paper. The grid consists of small, evenly spaced black dots arranged in horizontal and vertical rows across the entire page. There are no margins, text, or other markings present.

STATION

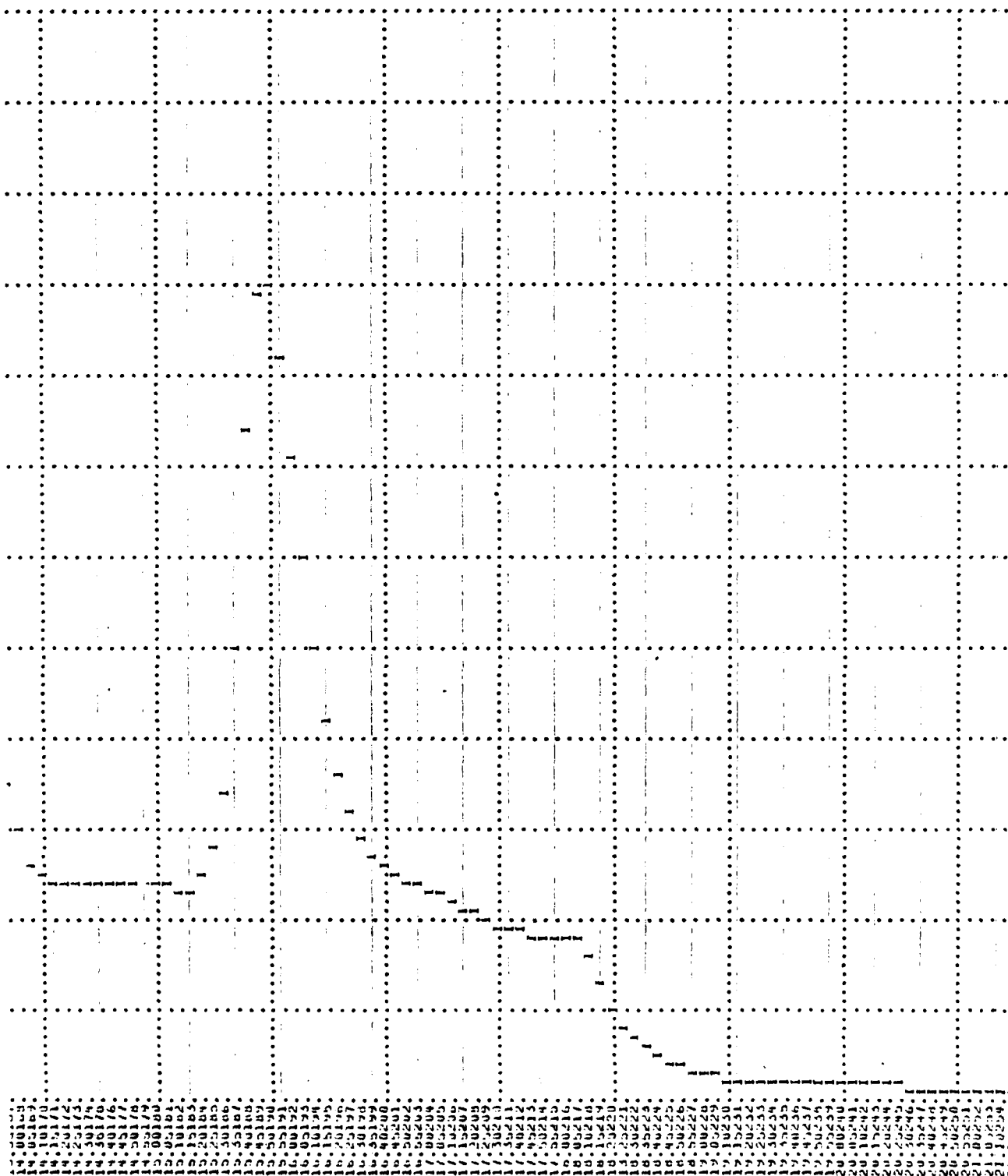
SUM OF 2 HYDROGRAPHS AT M 2+3		PLAN 1		RTIO 0		0.5 PMF	
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME	
CFS	450.	160.	45.	45.	12985.		
CMS	13.	5.	1.	1.	367.		
INCHES		10.17	18.21	18.21	18.21		
MM		410.83	462.47	462.47	462.47		
AC-FI		79.	89.	89.	89.		
THOUS CU H		98.	110.	110.	110.		

STATION 2+5 05 PMF

4404 *



[illegible]

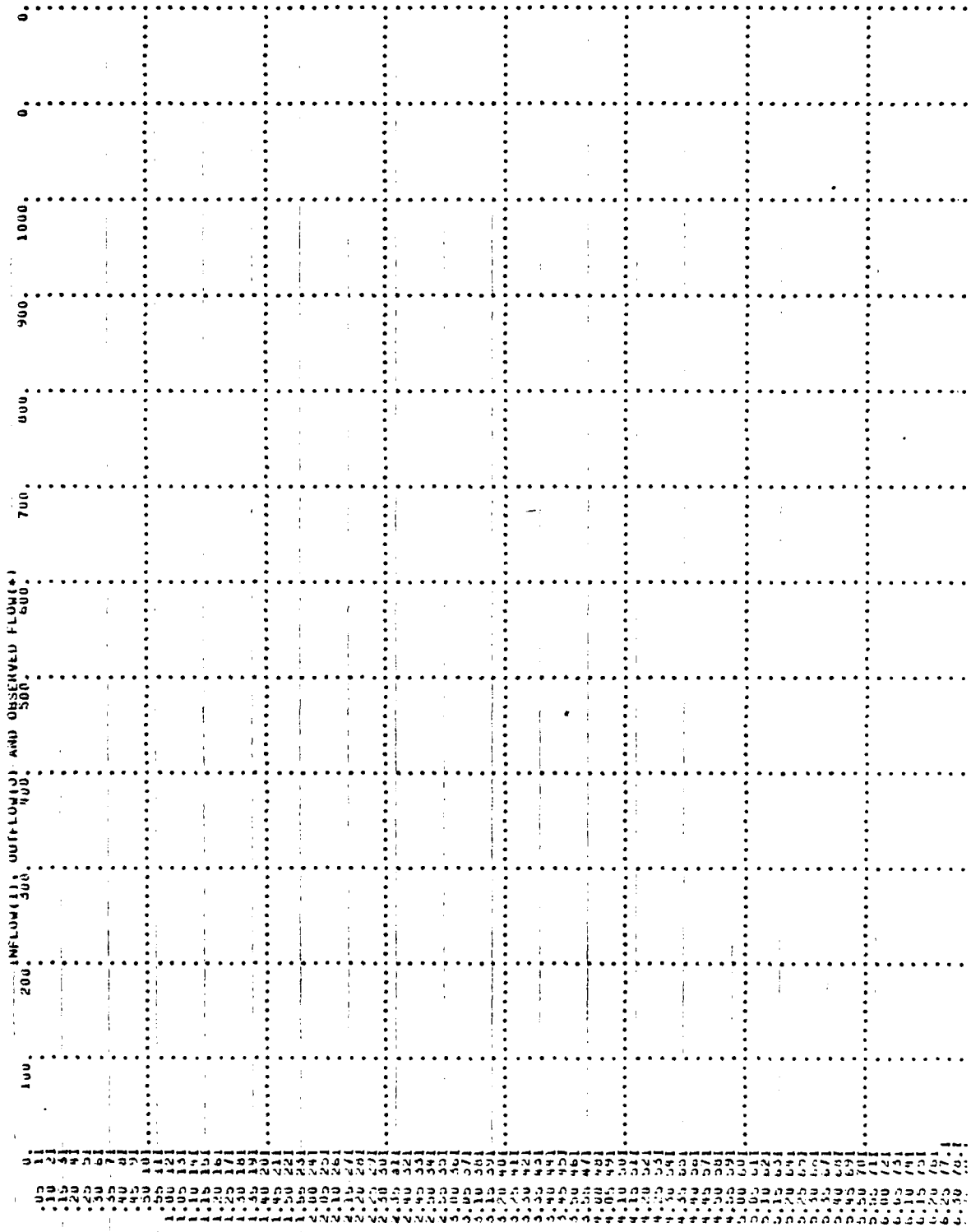


000114

SUM OF 2 HYDROGRAPHS AT A 243					PLAN 1	RTU 9	PMF
	PLAN	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME	
CS	925.	289.	85.	85.	24349.	289.	
CS	26.	8.	2.	2.	689.	689.	
INCINS		29.27	34.19	34.19	34.19	34.19	
MM		743.47	468.54	468.54	468.54	468.54	
AC-FT		144.	168.	168.	168.	168.	
11005 CU M		177.	207.	207.	207.	207.	

STATION 2+3 PMF

UNIT *



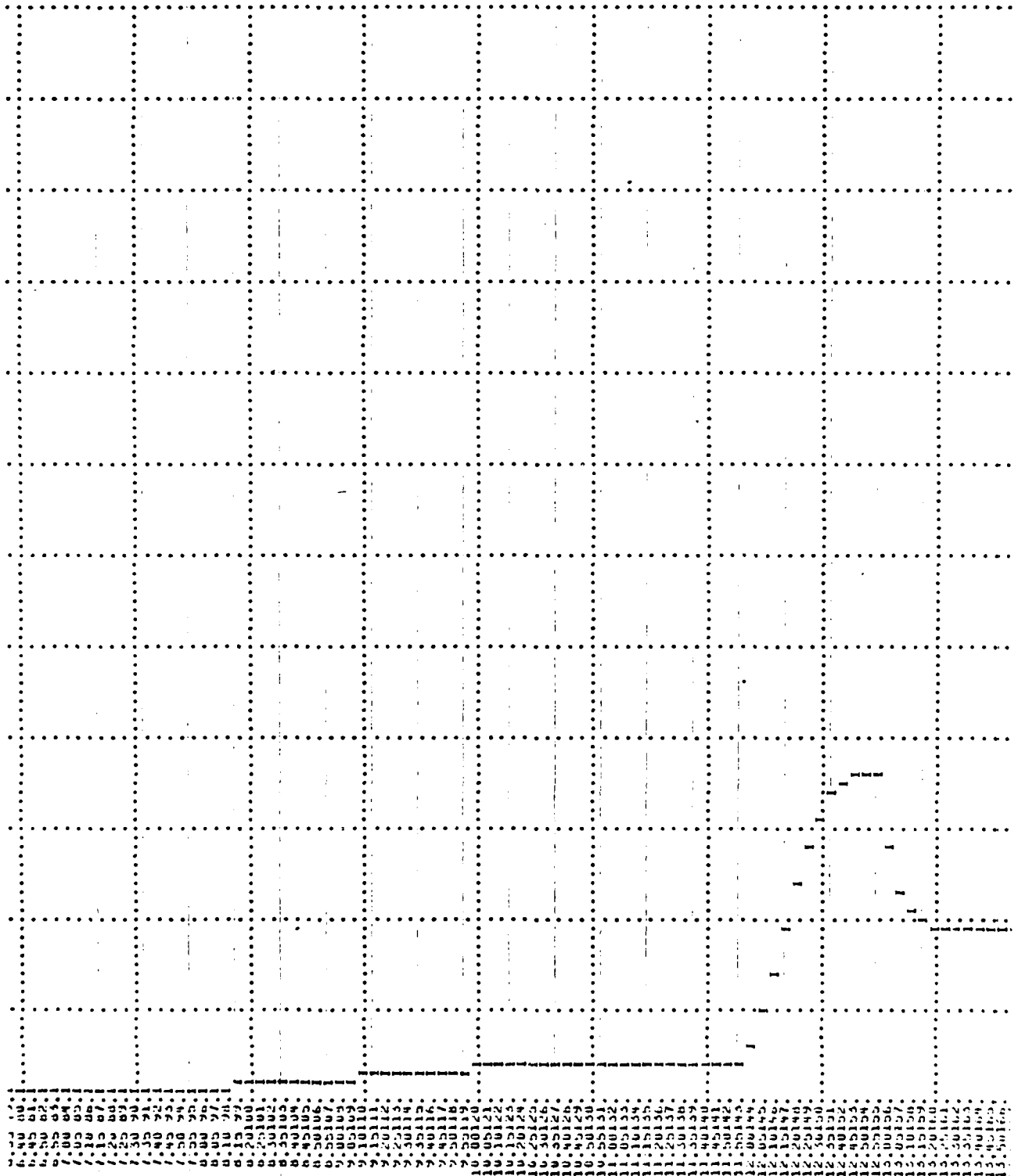


PLATE D-55

ROUTED FLOWS THROUGH LAKE TANGLEWOOD SOUTH DAM-MU 31224

CHFL	SI*MD	CUOM	EXPM	ELEV	COUL	CANEA	EXPL
450.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TOPPL	UAM DATA	DAMWID
472.9	COOD	- 2/S.
	2.9	1.5

CREST LENGTH
AT UK BELOW
ELEVATION

4.	38.	240.	266.	286.	322.	334.
472.9	473.0	473.4	474.0	475.0	476.0	477.0

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
 *** BOTTOM OF RESERVOIR ASSUMED TO BE AT 445.00
 *** STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 470.00

STATION 000004, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

[illegible]

0.10 PMF

STATION 00004, PLANT 1, RATIO 3 0

[illegible]

[illegible]

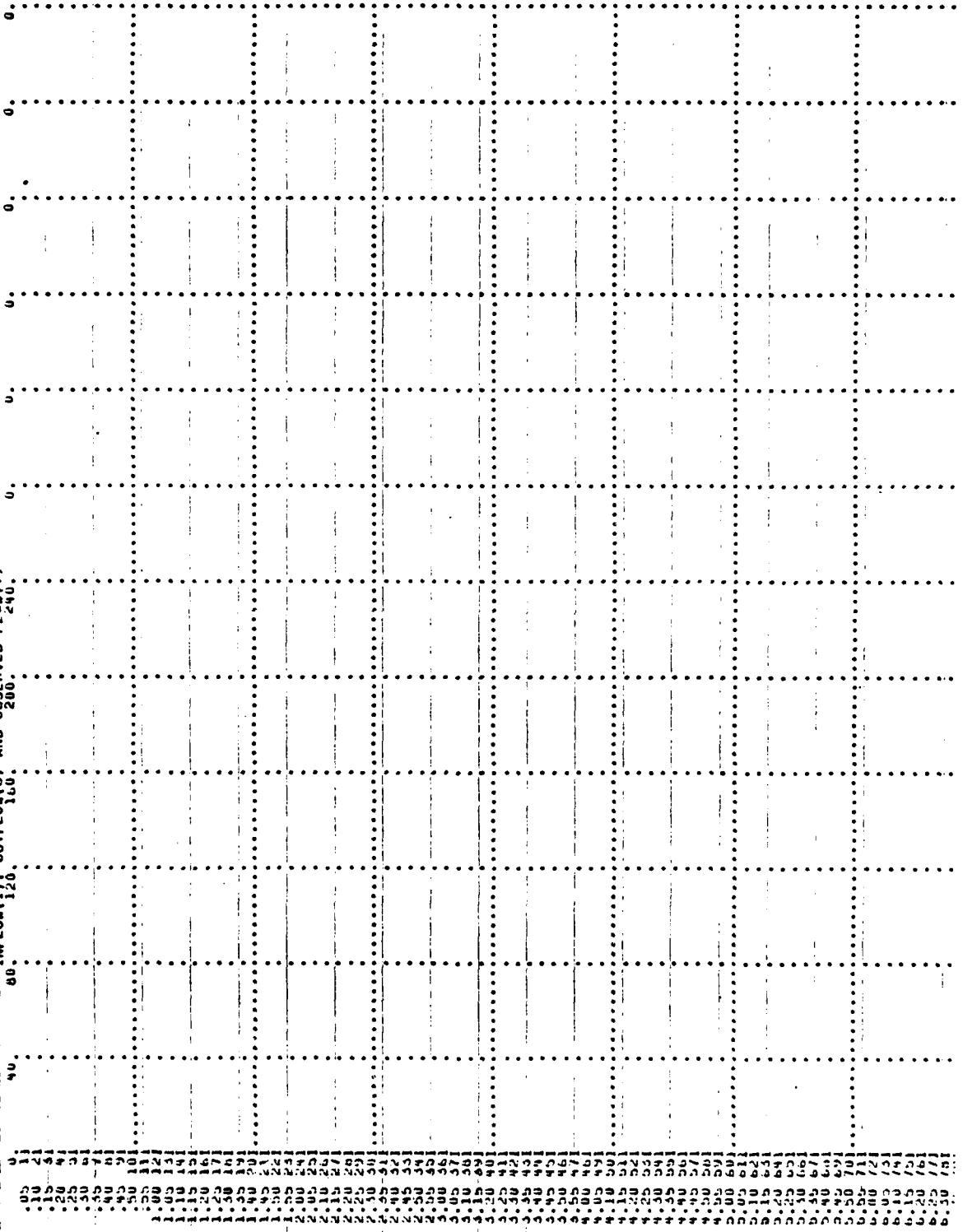
PEAK OUTPUT IS 141. AT TIME 17.00 HOURS

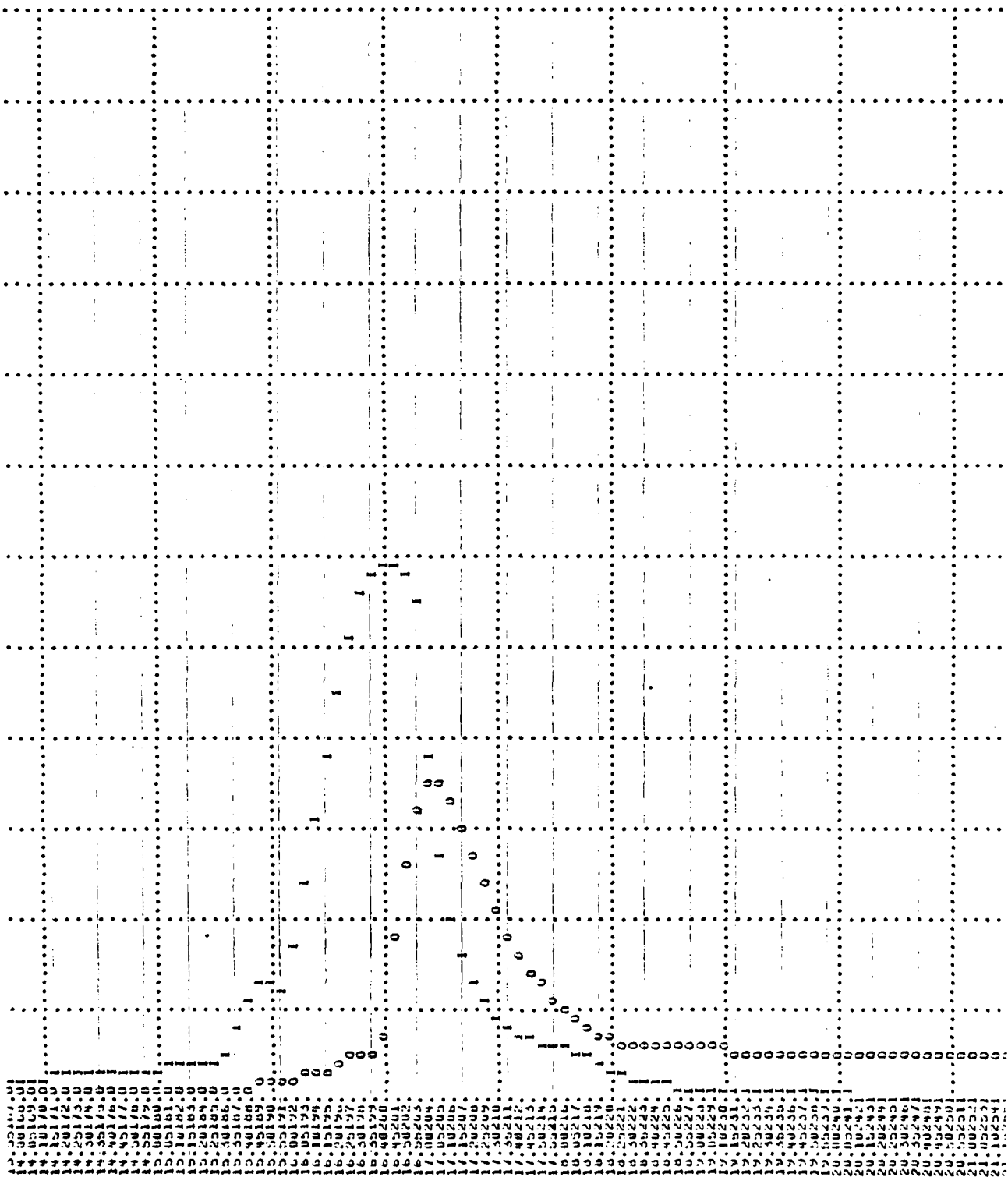
PLAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
141.	36.	1.	11.	397.	88.
4.	1.	0.	0.	0.	4.33
	3.68	4.33	4.33		110.47
	9.59	110.47	110.47		21.
		26.	26.		26.

STATION000004

00000

INFLOW(I); OUTFLOW(O) AND OBSERVED FLOW(F)



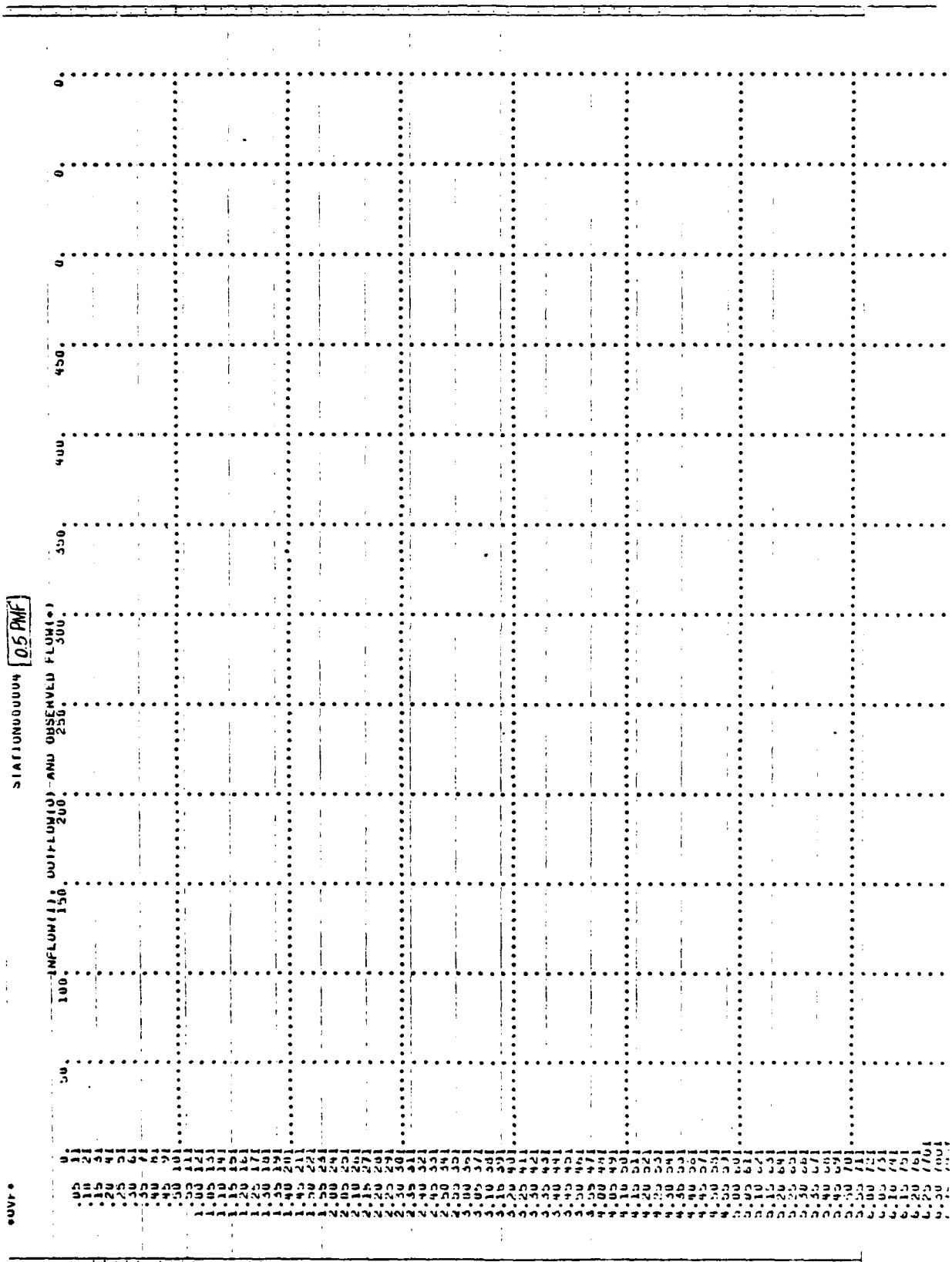


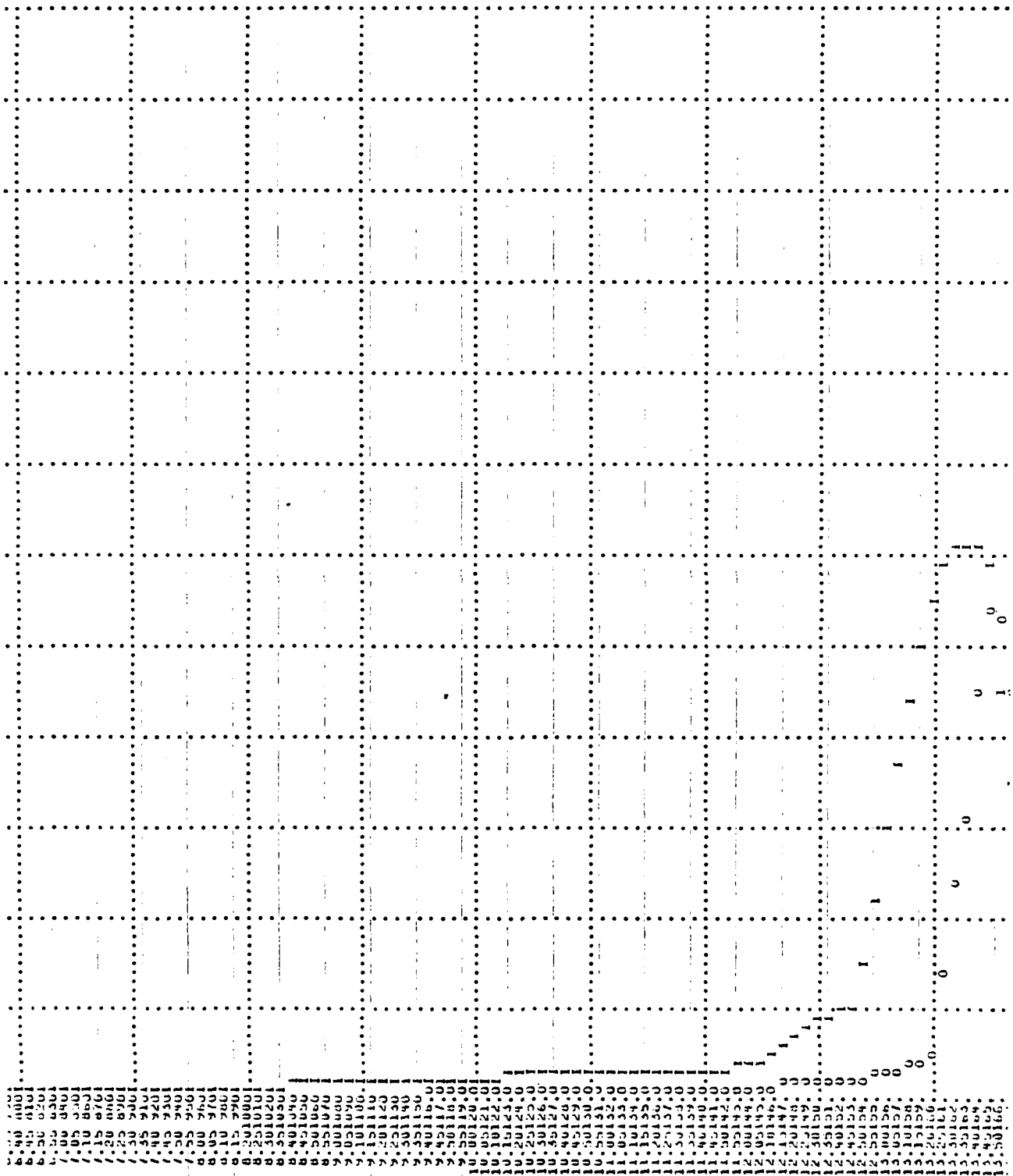
WARNING *** TOP OF DAM, BOTTOM OF HATCH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
 BOTTOM OF RESERVOIR ASSUMED TO BE AT 445.00
 STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 470.00

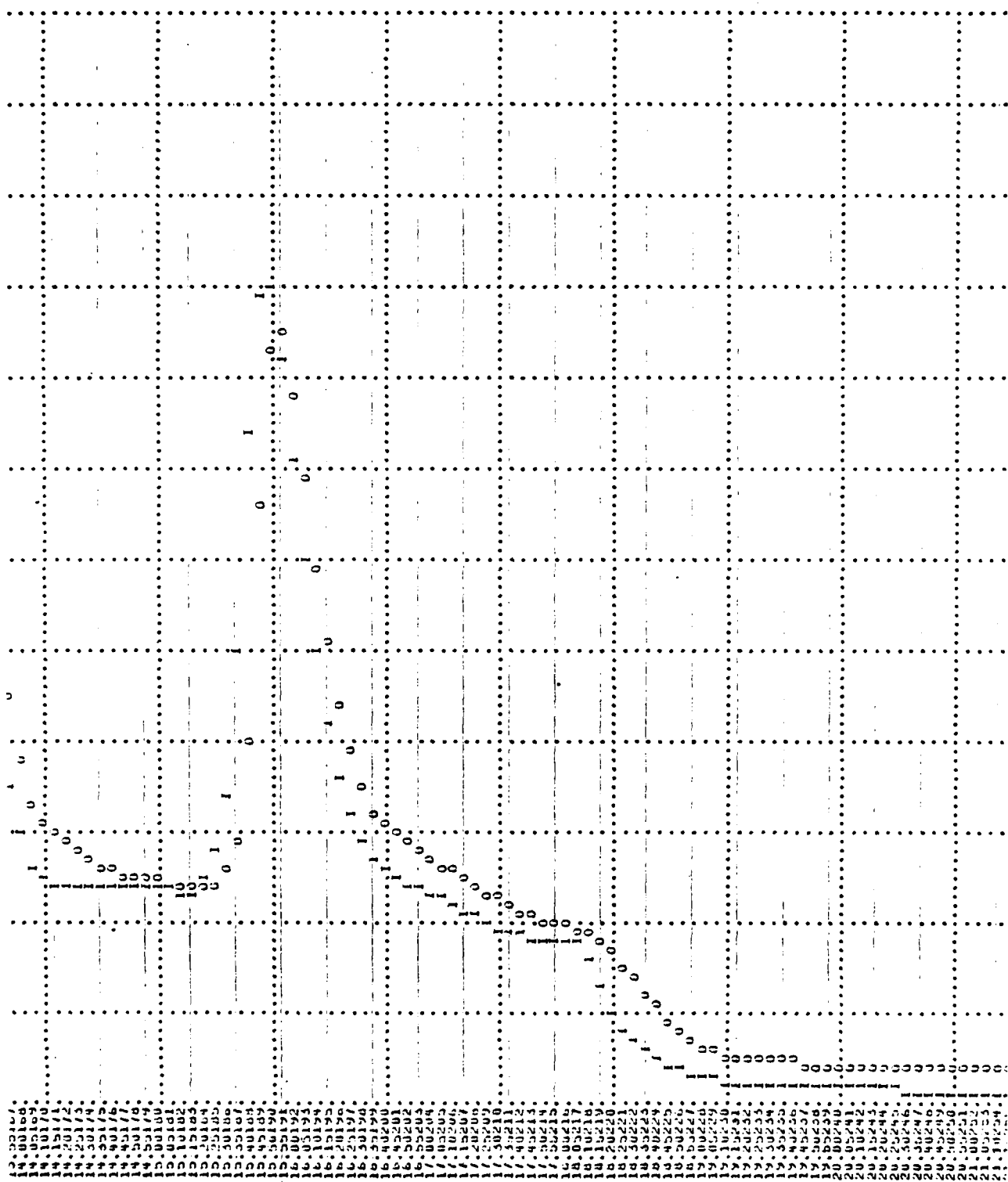
0.5 PMF

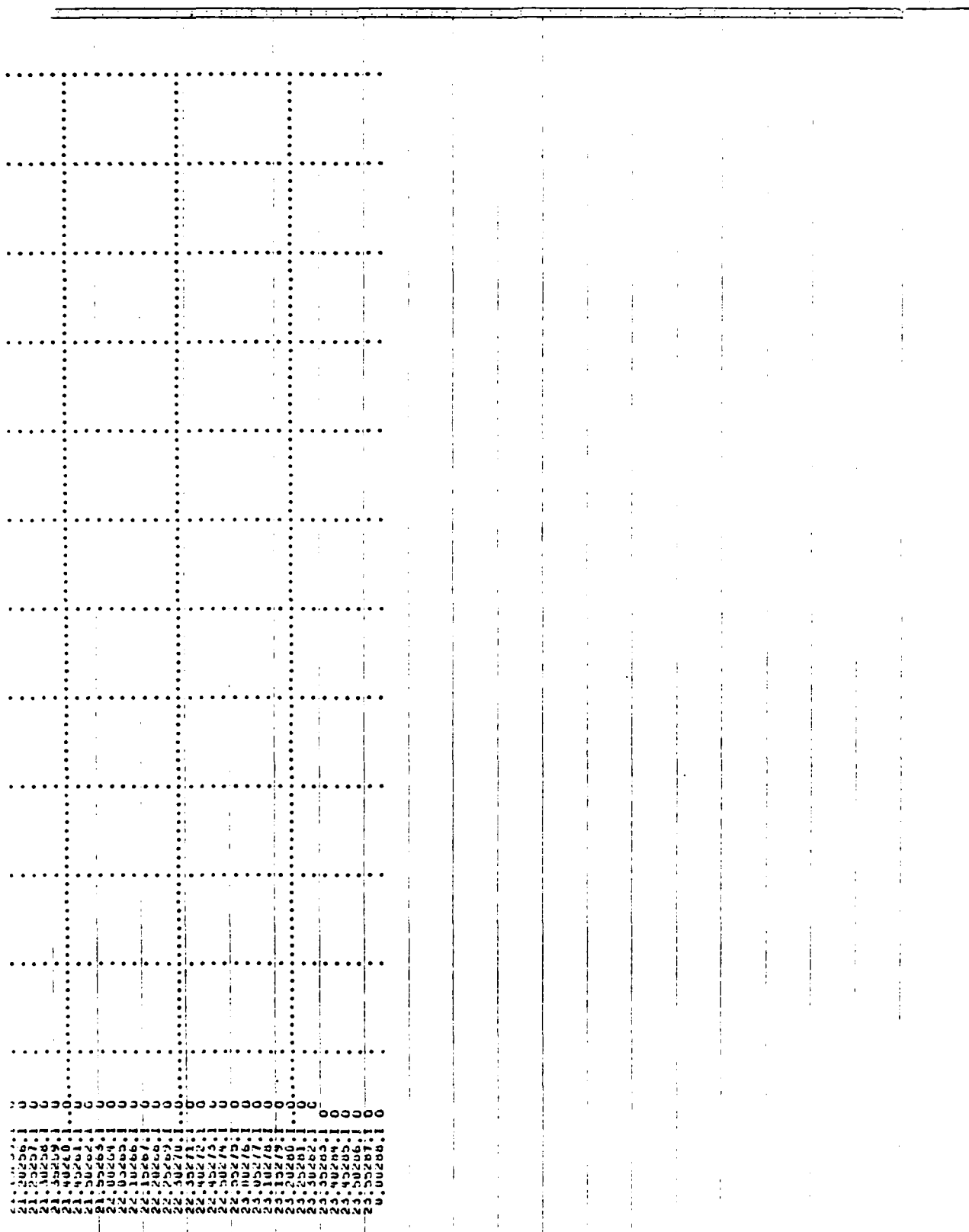
INDU-OF-PERIOD HYDROGRAPH ORIGINATES

[illegible][illegible][illegible]









●●●●●

WARNING *** TOP OF DAM, BOTTOM OF HATCH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
 BOTTOM OF RESERVOIR ASSUMED TO BE AT 435.00
 STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 470.00

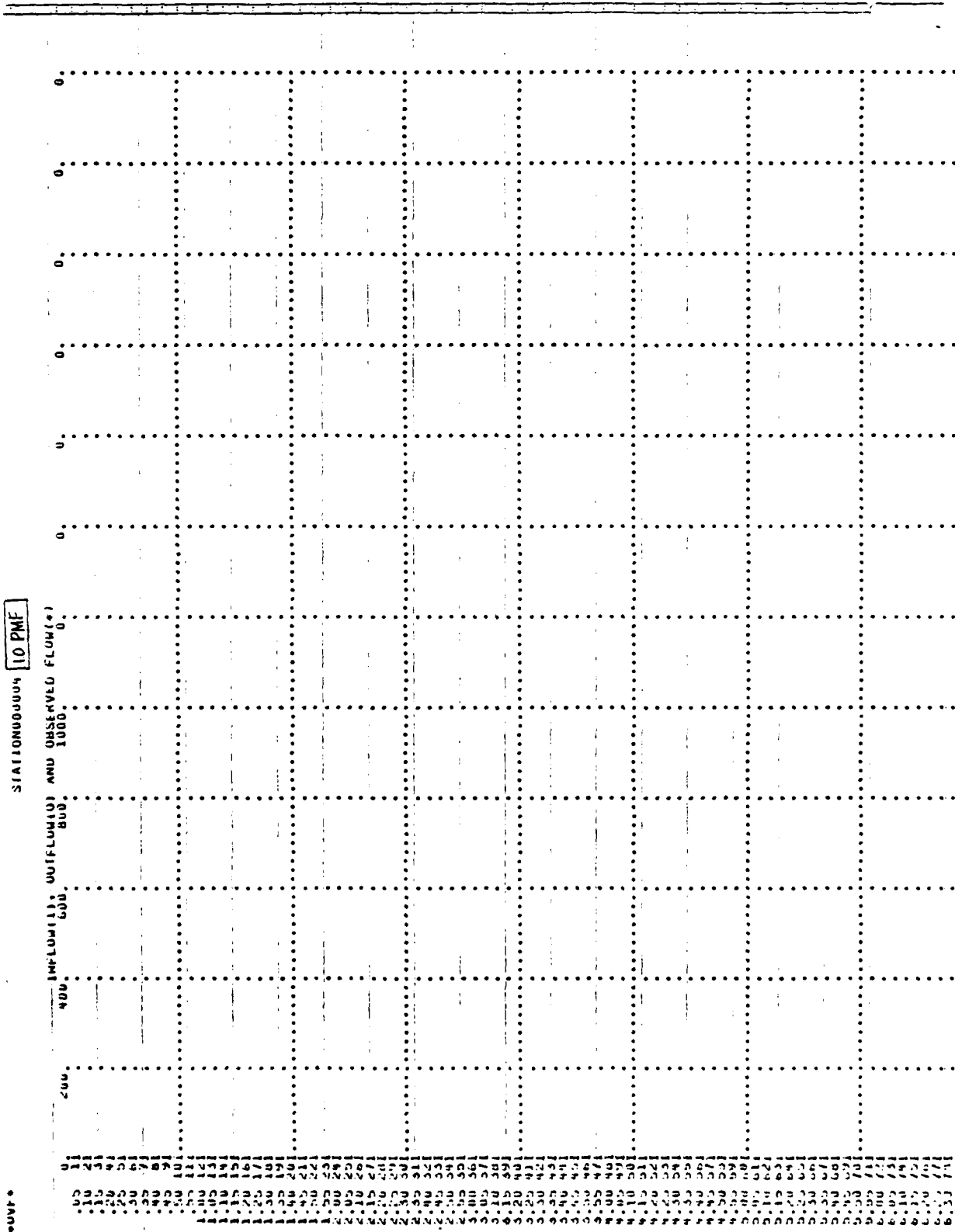
10 PMF

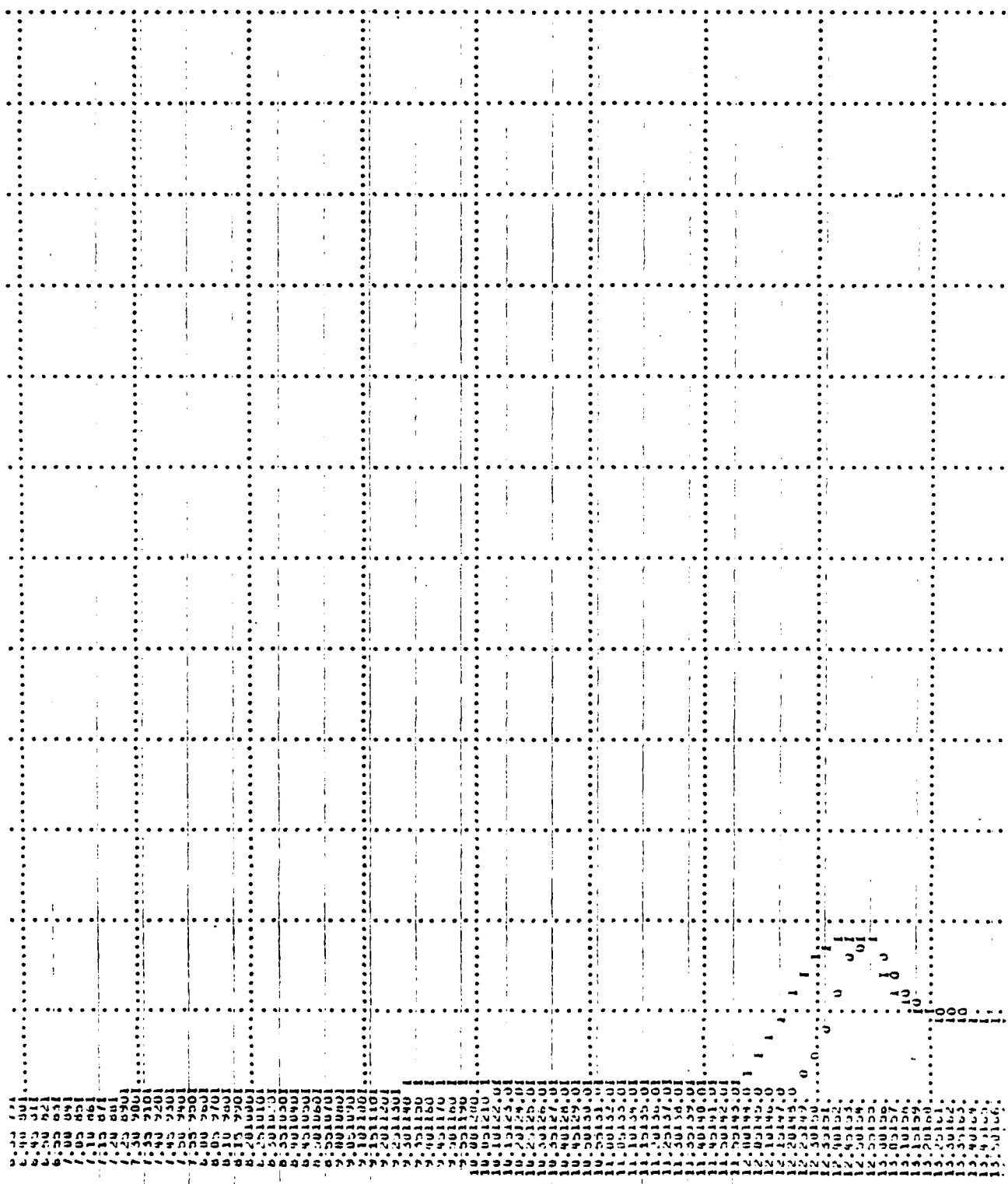
STATION 000004, PLAT. 1, KATIO 9100
LNU-OF-PLION HYDROGRAPH ORDINATES[illegible][illegible][illegible]

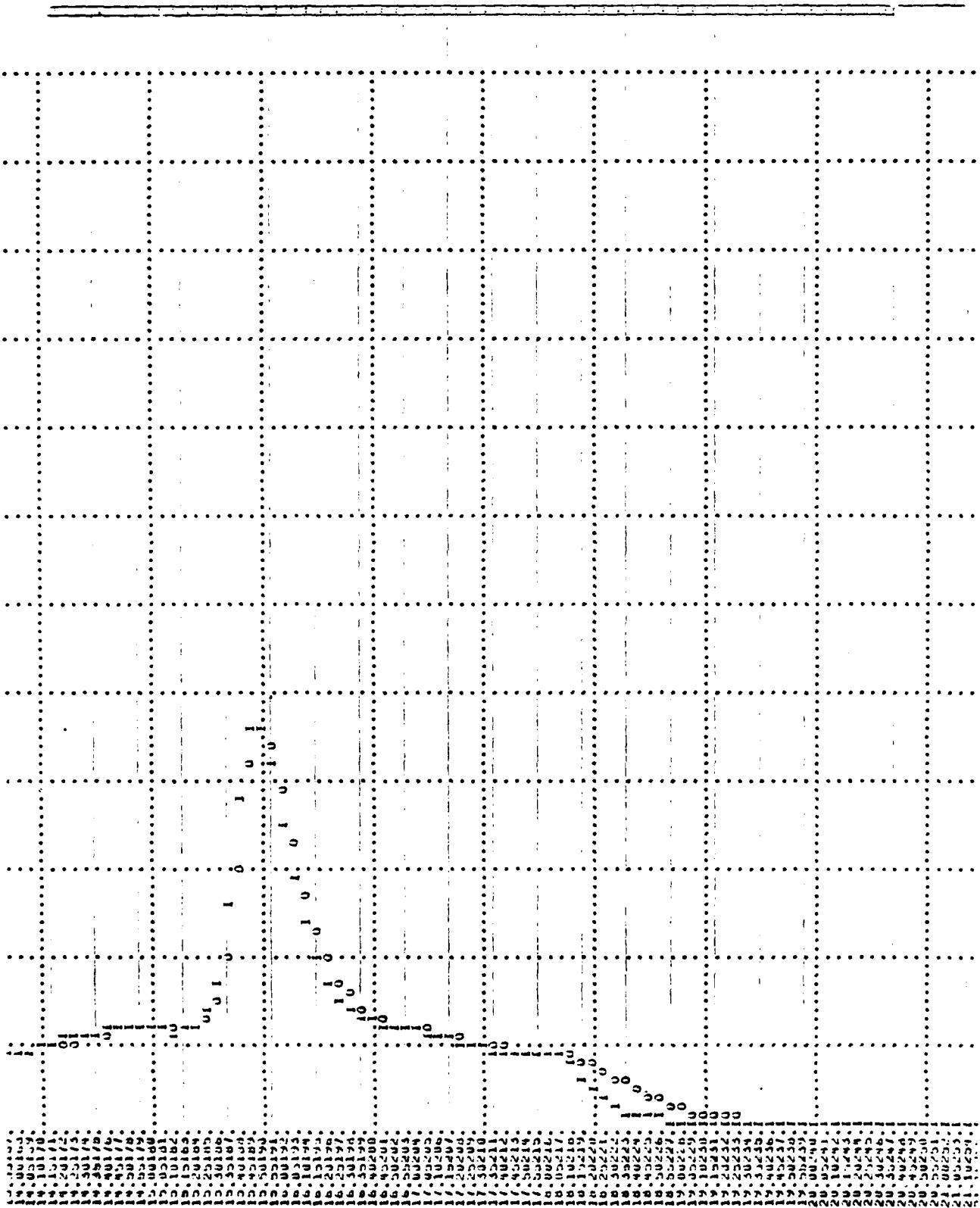
[illegible]

PEAK OUTFLOW IS 522. AT-TIME 15.63 HOURS

PLAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
922.	281.	80.	80.	2534.	547.
26.	2.	2.	2.	32.18	817.35
	28.46	32.18	32.18		158.
	722.56	617.35	617.35		193.
	140.	158.	158.		
	172.	193.	193.		







30227	30227	30227	30227
30228	30228	30228	30228
30229	30229	30229	30229
30230	30230	30230	30230
30231	30231	30231	30231
30232	30232	30232	30232
30233	30233	30233	30233
30234	30234	30234	30234
30235	30235	30235	30235
30236	30236	30236	30236
30237	30237	30237	30237
30238	30238	30238	30238
30239	30239	30239	30239
30240	30240	30240	30240
30241	30241	30241	30241
30242	30242	30242	30242
30243	30243	30243	30243
30244	30244	30244	30244
30245	30245	30245	30245
30246	30246	30246	30246
30247	30247	30247	30247
30248	30248	30248	30248
30249	30249	30249	30249
30250	30250	30250	30250
30251	30251	30251	30251
30252	30252	30252	30252
30253	30253	30253	30253
30254	30254	30254	30254
30255	30255	30255	30255
30256	30256	30256	30256
30257	30257	30257	30257
30258	30258	30258	30258
30259	30259	30259	30259
30260	30260	30260	30260
30261	30261	30261	30261
30262	30262	30262	30262
30263	30263	30263	30263
30264	30264	30264	30264
30265	30265	30265	30265
30266	30266	30266	30266
30267	30267	30267	30267
30268	30268	30268	30268
30269	30269	30269	30269
30270	30270	30270	30270
30271	30271	30271	30271
30272	30272	30272	30272
30273	30273	30273	30273
30274	30274	30274	30274
30275	30275	30275	30275
30276	30276	30276	30276
30277	30277	30277	30277
30278	30278	30278	30278
30279	30279	30279	30279
30280	30280	30280	30280
30281	30281	30281	30281
30282	30282	30282	30282
30283	30283	30283	30283
30284	30284	30284	30284
30285	30285	30285	30285
30286	30286	30286	30286
30287	30287	30287	30287
30288	30288	30288	30288
30289	30289	30289	30289
30290	30290	30290	30290
30291	30291	30291	30291
30292	30292	30292	30292
30293	30293	30293	30293
30294	30294	30294	30294
30295	30295	30295	30295
30296	30296	30296	30296
30297	30297	30297	30297
30298	30298	30298	30298
30299	30299	30299	30299
30300	30300	30300	30300

PEAK FLOW AND STORAGE (MINI OF PLAINS) SUMMARY FOR MULTIPLE PLANS-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (MINUTE METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

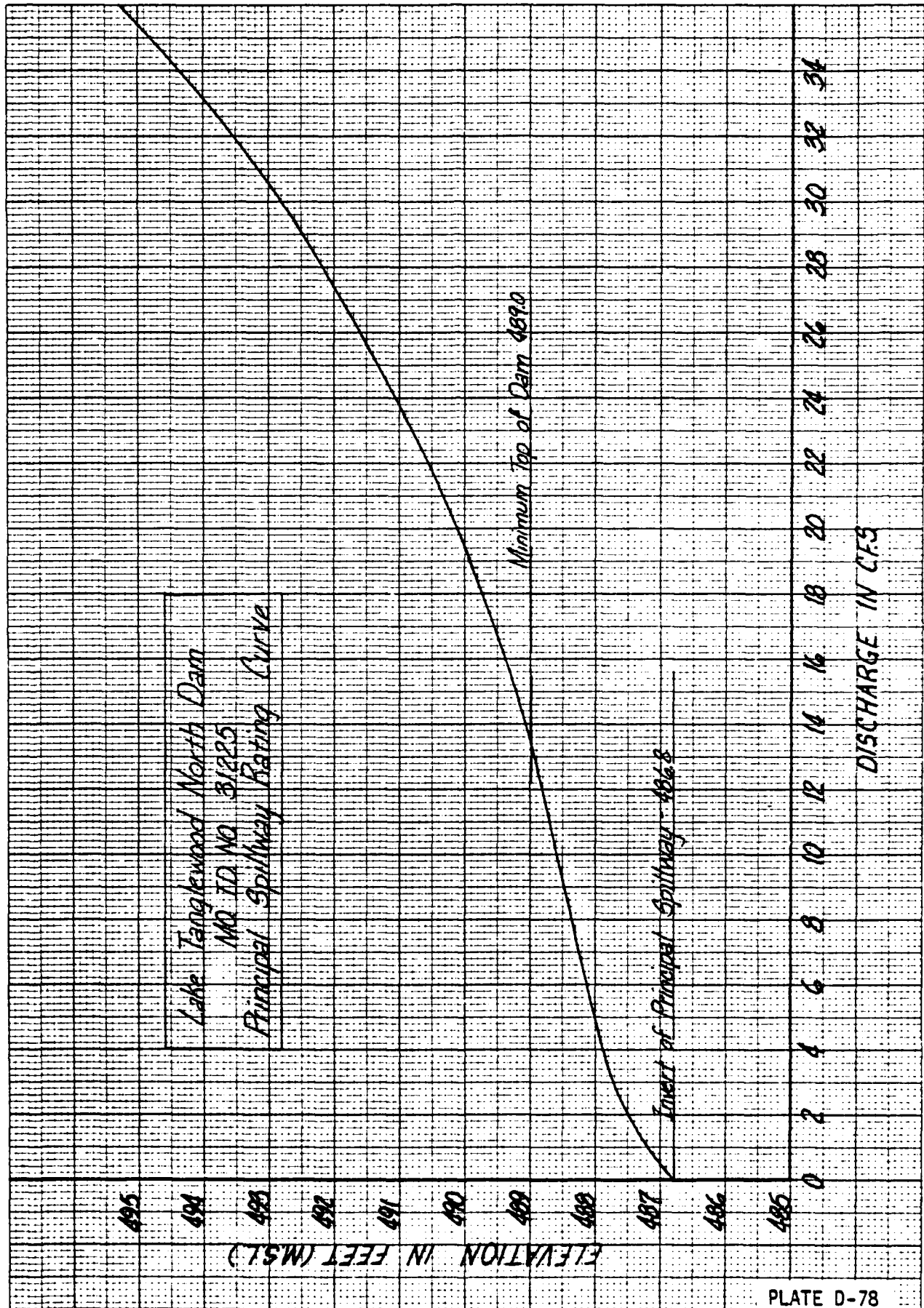
OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS									
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO 10
HYDROGRAPH AT	000001	.07	1	1.22	1.84	2.45	3.06	3.67	4.28	4.89	5.50	6.11	6.72
		.10											
ROUTED TO	000002	.07	1	.24	.56	1.00	1.44	1.88	2.32	2.76	3.20	3.64	4.08
		.10											
HYDROGRAPH AT	000003	.02	1	.39	.58	.77	.96	1.15	1.34	1.53	1.72	1.91	2.10
		.06											
2 COMBINED	000004	.04	1	.18	.32	.46	.60	.74	.88	1.02	1.16	1.30	1.44
		.24											
ROUTED TO	000004	.04	1	.15	.30	.45	.60	.75	.90	1.05	1.20	1.35	1.50
		.24											

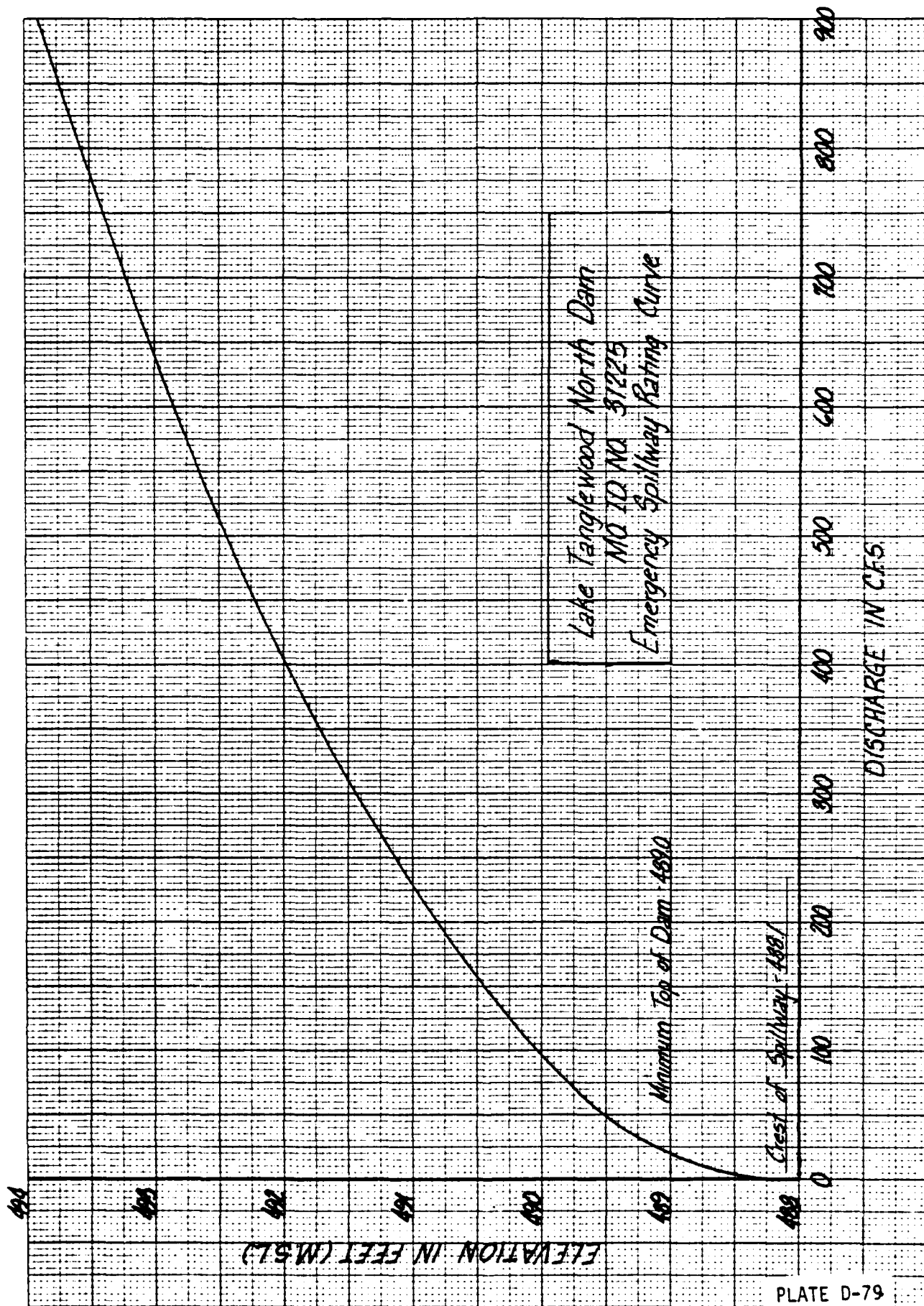
SUMMARY OF DAM SAFETY ANALYSIS

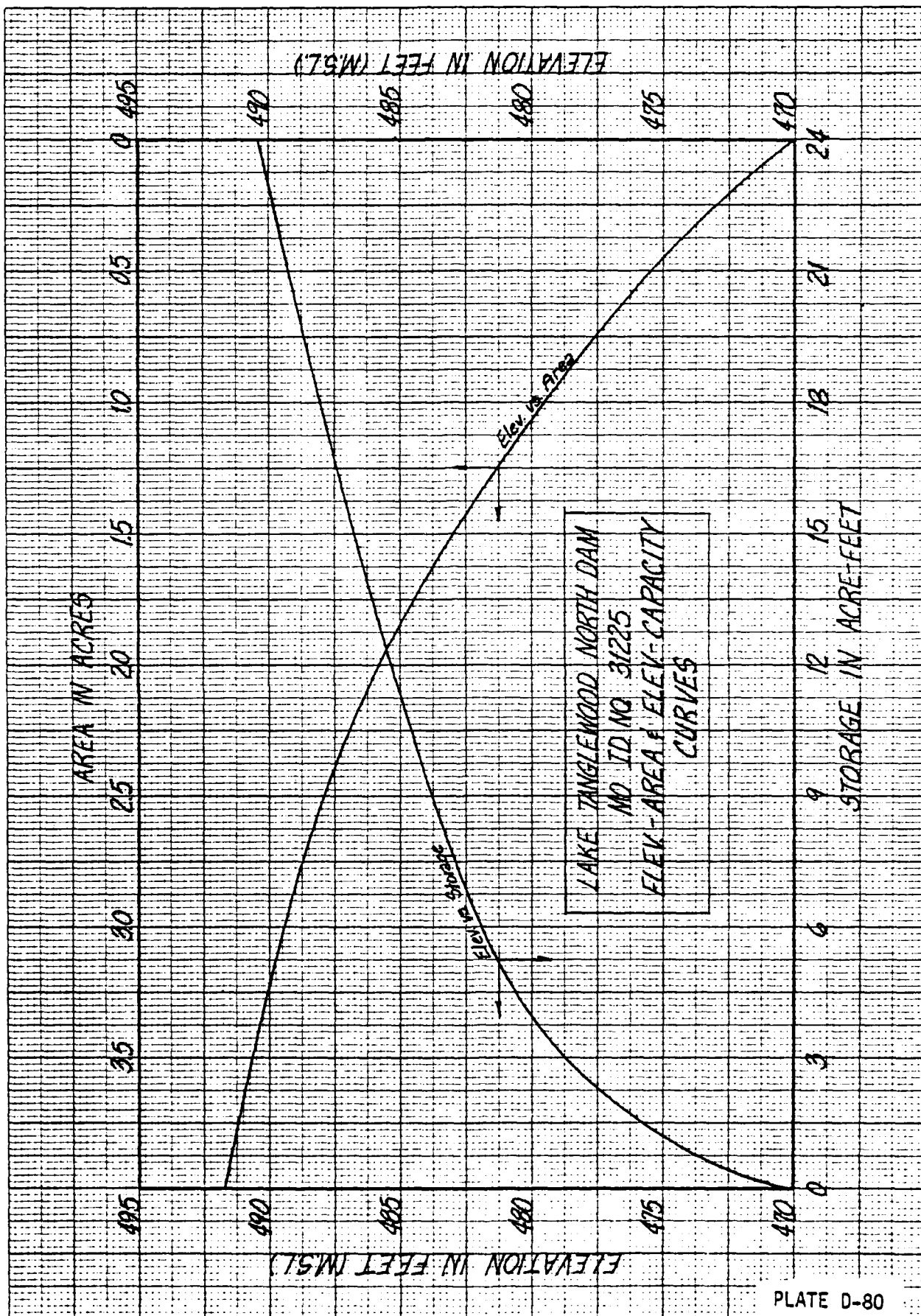
PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 486.80 15. U.	SPILLWAY CRIST 486.80 15. U.	TOP OF DAM 409.00 20. 32.				
RATIO OF PPE	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM ULP(H) OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS	
.05	488.24	0.00	18.	8.	0.00	17.08	0.00	
.08	488.69	0.00	19.	232.	0.00	16.17	0.00	
.10	489.02	.02	20.	275.	.19	16.89	12.72	
.15	489.19	.19	21.	274.	.31	16.30	12.67	
.20	489.30	.30	21.	279.	.48	16.08	12.42	
.25	489.42	.42	21.	314.	.79	15.50	12.50	
.50	489.02	.05	20.	261.	.19	15.83	12.75	
1.00	489.00	.00	20.	705.	.25	15.83	11.52	

SUMMARY OF DAM SAFETY ANALYSIS (With Breach)

PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALU. 466.00 16. 0.	SPILLWAY CREST 466.00 16. 0.	TOP OF DAM 472.90 32. 149.			
RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPT. OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	469.17	0.00	17.	6.	0.00	12.17	0.00
.08	472.82	0.00	21.	11.	0.00	16.20	0.00
.10	473.03	0.00	22.	13.	0.00	16.83	0.00
.15	473.14	.33	31.	20.	.75	16.67	0.00
.20	473.24	.44	34.	26.	.75	15.33	0.00
.25	473.19	.29	34.	2267.	1.22	15.75	0.00
.50	473.40	.50	35.	927.	1.22	15.22	0.00
1.00	473.81	.91	37.	922.	5.03	15.03	0.00







A1	ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF	
A2	H & H ANALYSIS OF SAFETY OF LAKE TANGLEWOOD NORTH DAM	
A3	RATIOS OF PMF THROUGH RESERVOIR MO 31225	
B	0002880000000000000005	000000000000000000000003
B1	0000005	
J	0000010000000000000001	0000000.2500000.3000000.3500000.50000001.0
J1	0000.0500000.1000000.1500000.	000000000000000000000001
K	0000000000000000000001	
K1	CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 31225	
M	00000100000000200000.07	00000.07000001.0
P	00000000000027.000000010200000121000000130	
T		-1.0 -78.0
W2	00000.17	
X	000000 -010000000001	
K	000001000000002	00000002000000000000000001
K1	ROUTED FLOWS THROUGH RESERVOIR 31225	
Y	000000001000000001	
Y1	0000001	
Y4	0486.8000487.5000488.0000488.5000489.0000489.5000490.0000491.0000491.5	-486.8
Y4	0492.0000492.5000493.0000493.5000494.0	-1
Y5	00000000000002000000005000000120000003200000006700000115000001770000025400000336	
Y5	00042700000539000006710000081200000983	
\$A	0000000000001.1000002.2000003.2000004.8	
\$L	000470000004800000486.8000000490000000500	
\$3	0486.8	
\$D	0489.0000002.9000001.500000290	
\$L	000000000000470000009800000146000001830000023300000325000003300000033500000340	
\$V	0489.0000489.3000489.6000490.0000490.0000490.3000490.6000491.0000492.0000493.0000494.0	
K	000099	
A		
A		
A		
A		
A		

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 000001

ROUTE HYDROGRAPH TO 000002

END OF NETWORK

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

.....
.....
.....

STATION	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
1	865.	200.	60.	60.	17268.	17268.
2	24.	2.	2.	2.	489.	489.
3	26.56	31.87	809.55	31.87	809.55	809.55
4	678.99	119.	119.	119.	119.	119.
5	122.	147.	147.	147.	147.	147.
SUM	35.10	31.93	31.17	31.17	17278.	17278.
	(892.1)	(811.1)	(81.1)	(81.1)	469.26)	

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

STATION	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
1	43.	10.	3.	3.	863.	863.
2	1.	0.	0.	0.	24.	24.
3	33.73	1.59	1.59	1.59	1.59	1.59
4	5.	40.48	40.48	40.48	40.48	40.48
5	6.	6.	6.	6.	6.	6.
6	7.	7.	7.	7.	7.	7.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

STATION	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
1	62.	20.	0.	0.	172.	172.
2	2.	0.	0.	0.	4.	4.
3	2.66	3.19	3.19	3.19	3.19	3.19
4	67.47	80.96	80.96	80.96	80.96	80.96
5	10.	12.	12.	12.	12.	12.
6	15.	15.	15.	15.	15.	15.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

STATION	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
1	130.	31.	7.	7.	2590.	2590.
2	4.	7.	7.	7.	7.	7.
3	3.98	4.74	4.74	4.74	4.74	4.74
4	101.20	121.43	121.43	121.43	121.43	121.43
5	15.	18.	18.	18.	18.	18.
6	18.	22.	22.	22.	22.	22.

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CF5	17.5	4.0	12.	10.	34.5	34.5
CMS	1.5	0.7	0.7	0.7	3.6	3.6
INCHES	1.5	1.5	6.3	6.3	15.6	15.6
AM	1.5	1.5	16.3	16.3	16.3	16.3
AC-FT	2.0	2.0	24.	24.	24.	24.
CU M	2.0	2.0	29.	29.	29.	29.
THOUS						

HYDROGRAPH AT STA00001 FOR PLAN 1, RTIO 5

PLAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
216.	50.	15.	15.	15.	45.
6.	1.	0.	0.	1.	1.
	6.8	7.3	7.9	23.1	23.1
	168.8	202.3	202.3	202.3	202.3
	3.	30.	30.	30.	30.
	31.	37.	37.	37.	37.

HYDROGRAPH AT STA00001 FOR PLAN 1, RTIC 6

PLAN	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
259.	60.	18.	18.	519.	17.
7.	2.	1.	1.	5.	3.
	7.	3.	3.	23.	3.
	20.	24.	24.	242.	36.
	31.	46.	46.	44.	44.

HYDROGRAPH AT STA000091 FOR PLAN 1, HYD 7

	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
PEAK	78.	21.	21.	604.	
303.	2.	1.	1.	11.	
CFS	2.	1.	1.	11.	
CHS	2.	1.	1.	11.	
INCHES	2.	1.	1.	11.	
MM	2.	1.	1.	11.	
AC-FT	2.	1.	1.	11.	
THOUS CU YD	2.	1.	1.	11.	

HYDROGRAPH AT STA00001 FOR PLAN 1, HYD 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	432.	100.	30.	1.		8634.
CMS	12.	3.	1.	14.		244.
INCHES		17.8	15.94	15.94		244.
MM		457.3	404.78	404.78		15338
AC-FT		50.	59.	59.		404.78
THOUS CU M		61.	73.	73.		59.
						73.

HYDROGRAPH AT STA000001 FOR PLAN 1, NTIU 9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	865.	200.	60.	27.	27.	17258.
CMS	24.	6.	24.	24.	24.	48.
INCHES		26.56	31.87	31.87	31.87	31.87
AC-FY		674.66	809.55	809.55	809.55	809.55
THOUS CU YD		12.	149.	149.	149.	149.

HYDROGRAPH ROUTING									
ROUTED FLOWS THROUGH RESERVOIR 31225									
ISTAB	ICOMP	IECON	ITAPL	JPL1	JPL2	JPR1	INAME	ISTAGE	IAUTO
000002	1	0	0	0	2	0	1	0	0
QLOSS	CLOSS	AVG	ROUTING DATA	IOPT		IPMP			
0.0	0.000	0.00	INLS ISAME	1	0	0			
			LAG	AMSCK	X	TSK	STOKA	ISPKAT	
			0	0	0.000	0.000	-487.	-1	
486.80	487.50	488.00	488.50	489.00	489.50	489.50	490.00	490.50	490.50

[illegible]

NOTHING

STORAGE

[illegible]

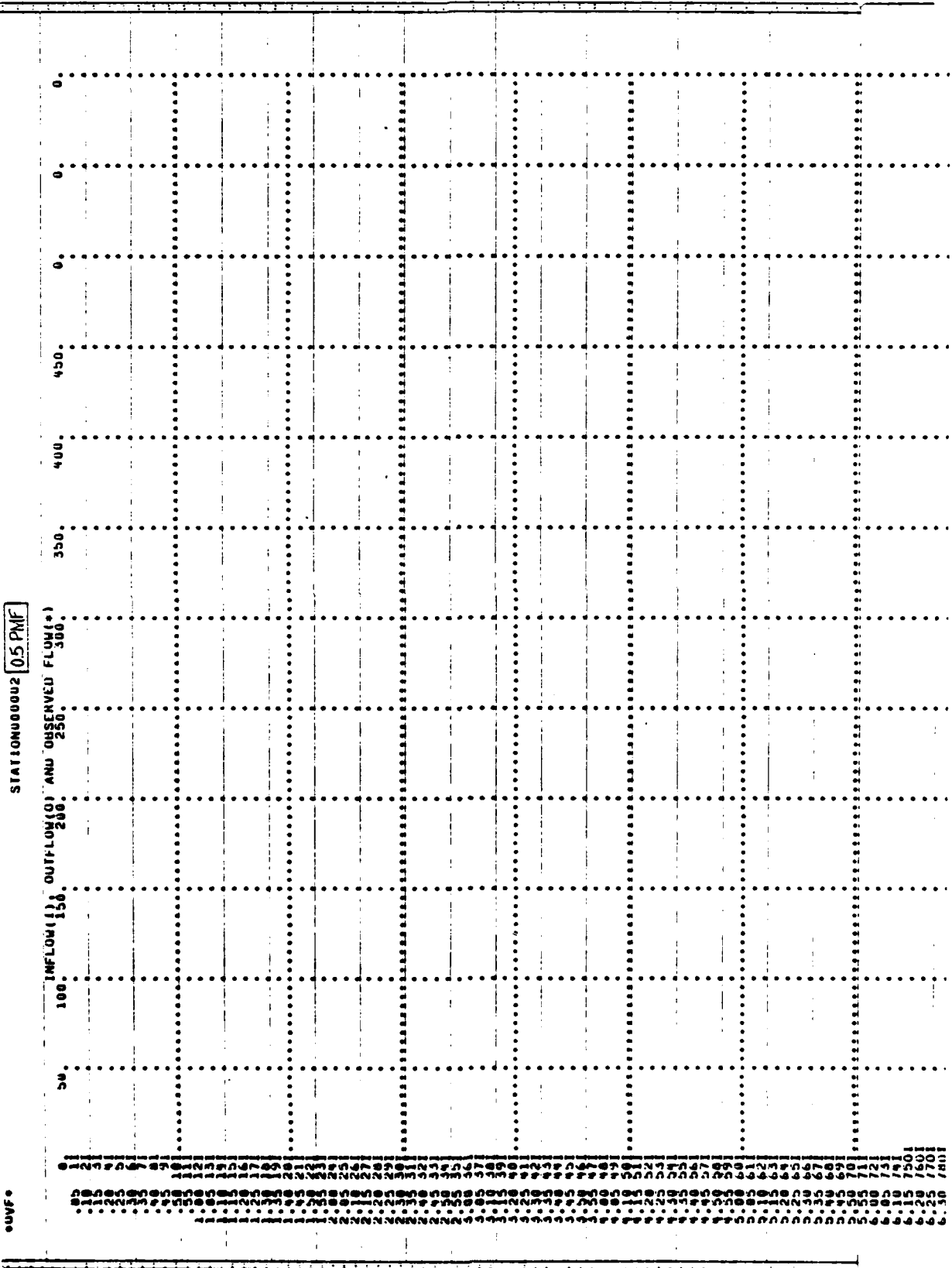
STAGE

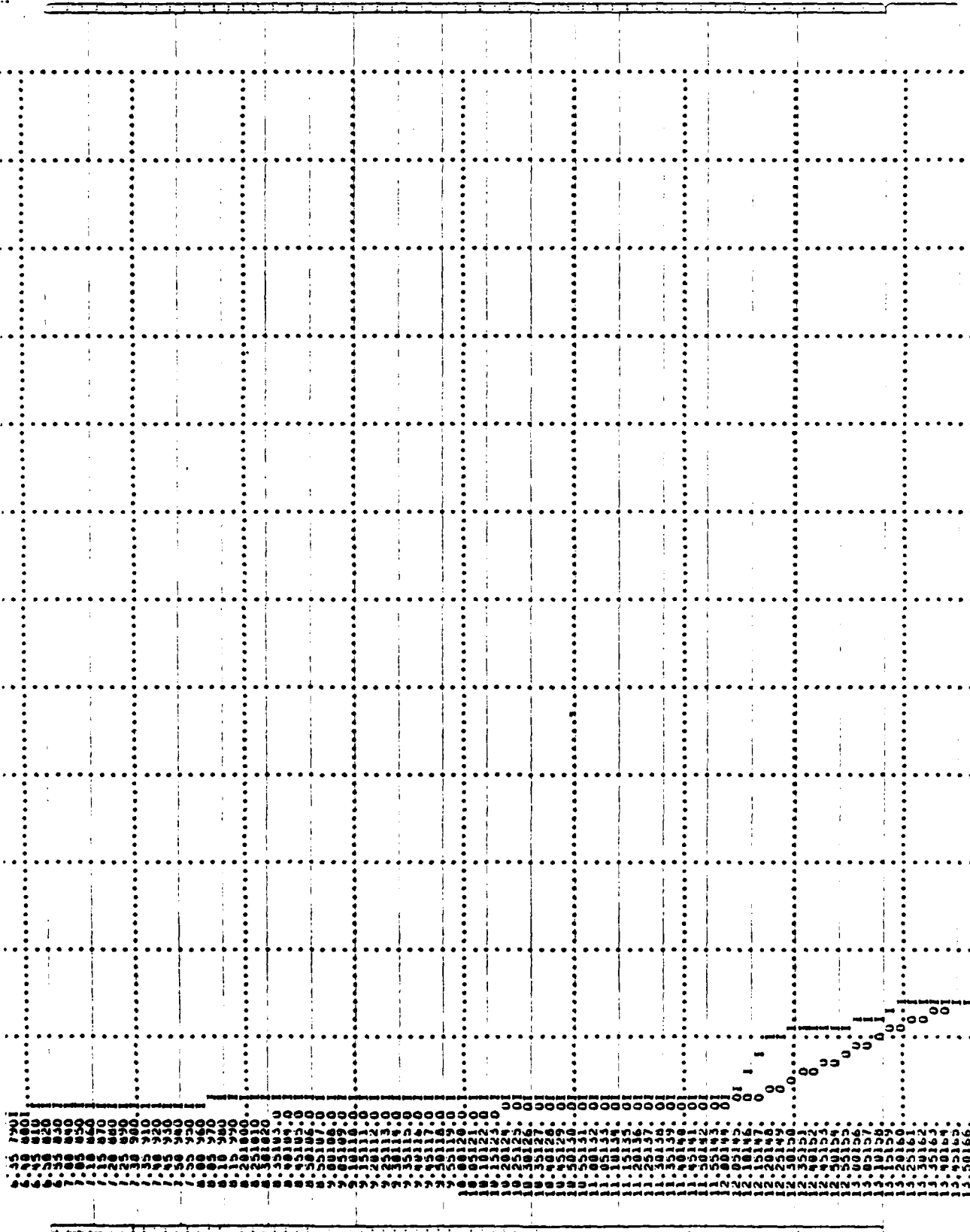
[illegible]

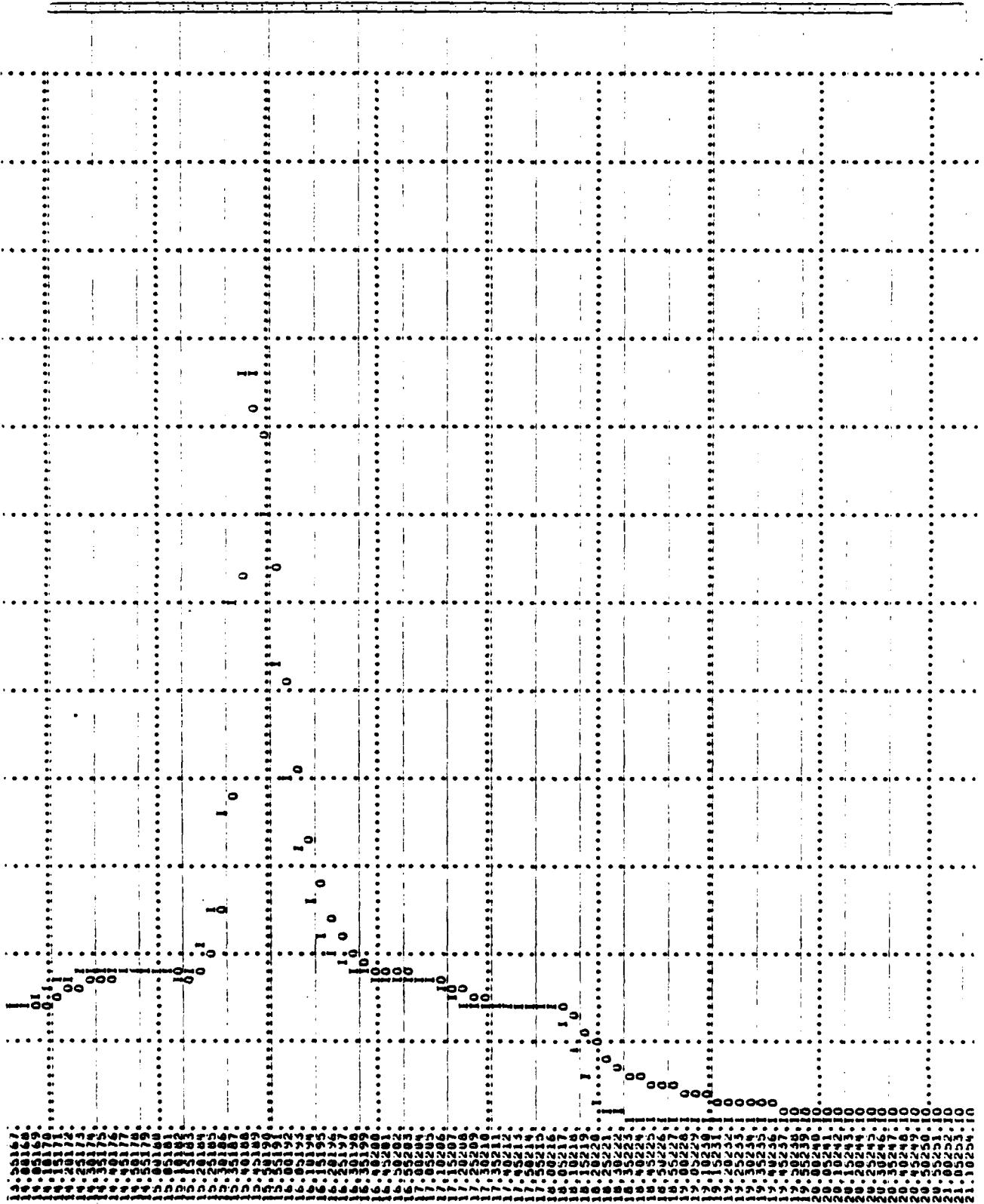
PLAK OUTFLOW IS 410. AT TIME 15.75 HOURS

PLAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
410.	31.	28.	28.		410.
12.	12.24	15.10	1.10		137.1
	328.84	363.71	363.71		137.1
	30.	30.	30.		30.
					56.1
					56.1

CES
 INCHES
 AC-FI
 THOUS CU H









• NAME

.....
 000000-NT-01000000-07-04-000000
 00000000000000000000

0000000126144916331291267711211

[illegible]

.....

.
000000002712819619222222222222

.....
00000000001401110017100000000000

000000000140001029404647804722

[illegible]

.....

.....

.....
ഗവൺമെന്റ് ഓഫ് കേരളം
 ഗവണ്മെൻ്റ് ഓഫ് കേരളം

.....
 ၂၀၂၀-၂၀၂၁ ခုနှစ် နှစ်စာရင်း ဝင်ငွေနှင့် ဝင်ငွေအသုံးအကျဉ်းချုပ်
 ၂၀၂၀-၂၀၂၁ ခုနှစ် နှစ်စာရင်း ဝင်ငွေနှင့် ဝင်ငွေအသုံးအကျဉ်းချုပ်

.....
 11111111116811200012222222222911911

.....

[illegible][illegible][illegible]

.....

[illegible]

.....

පරිසර සම්පත් - පරිසරය
පරිසරයේ වෙනස්කම්

ॐ नमो भगवते वासुदेवाय ॥ १ ॥
 ॐ नमो भगवते वासुदेवाय ॥ २ ॥

ॐ नमो भगवते वासुदेवाय ॥
 ॐ नमो भगवते वासुदेवाय ॥

[illegible]

.....

STAGE

.....

|

മതഭരണകമ്മിഷൻ റൂൾബുക്ക്

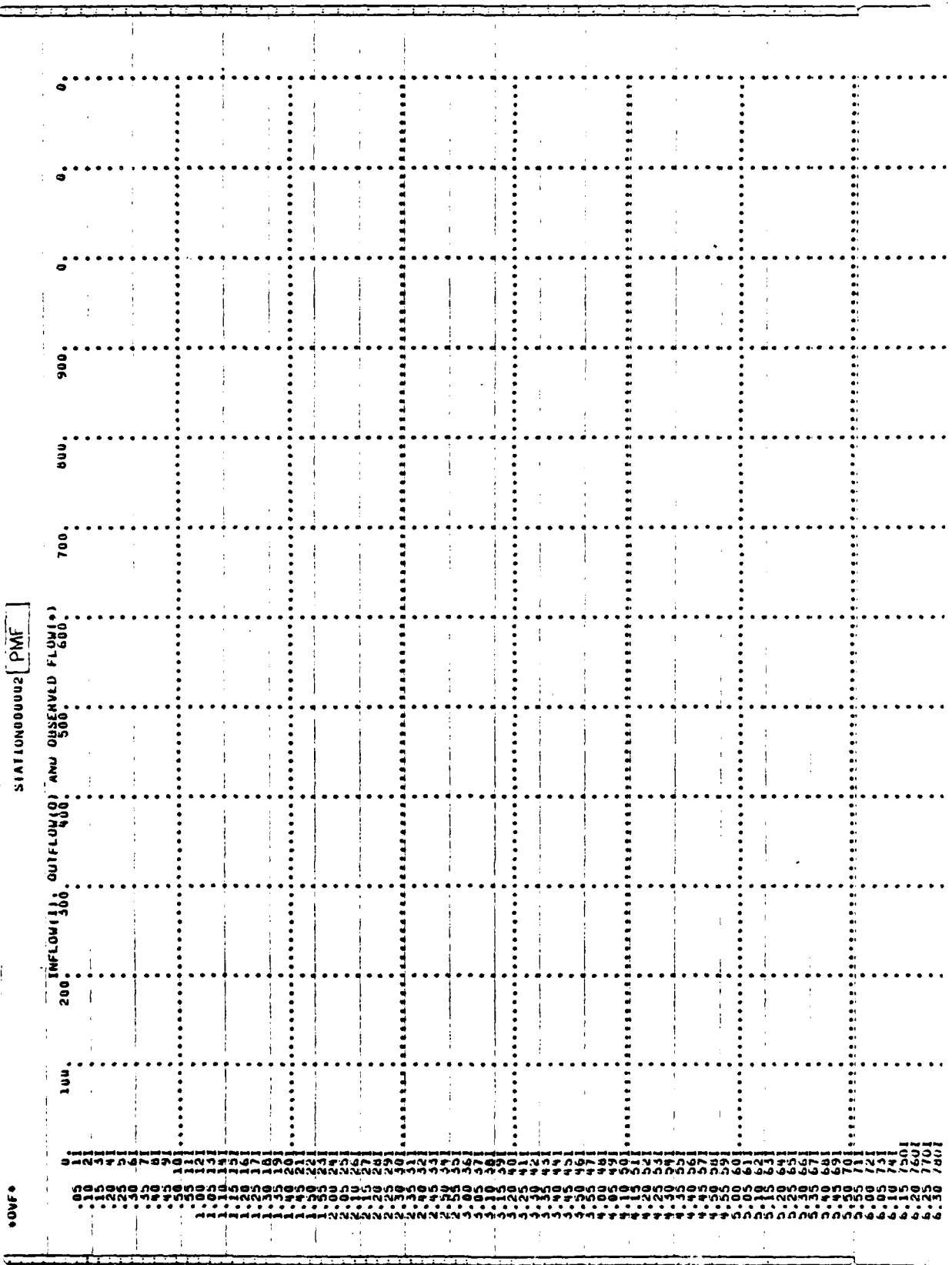
• • • • •

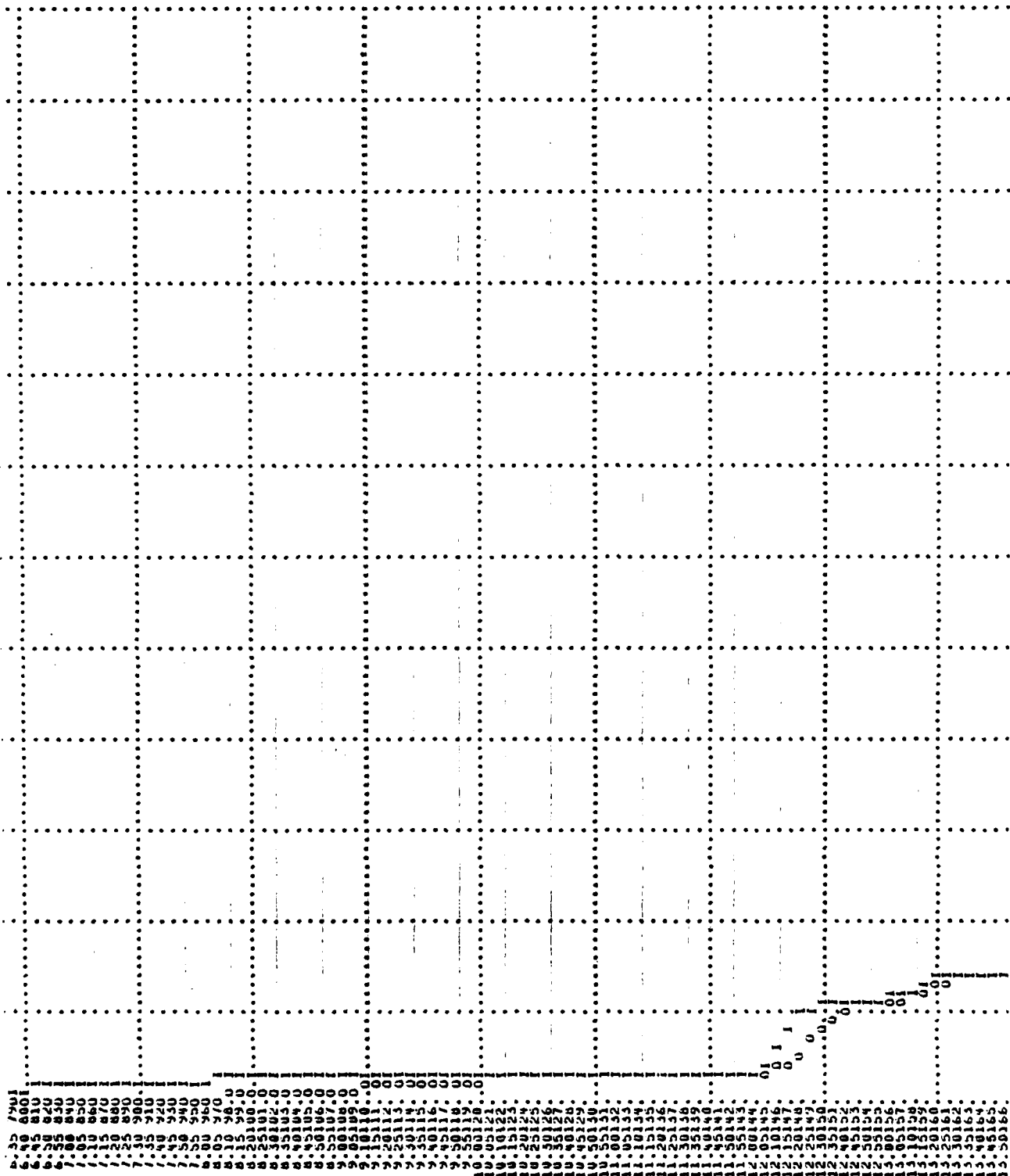
[illegible]

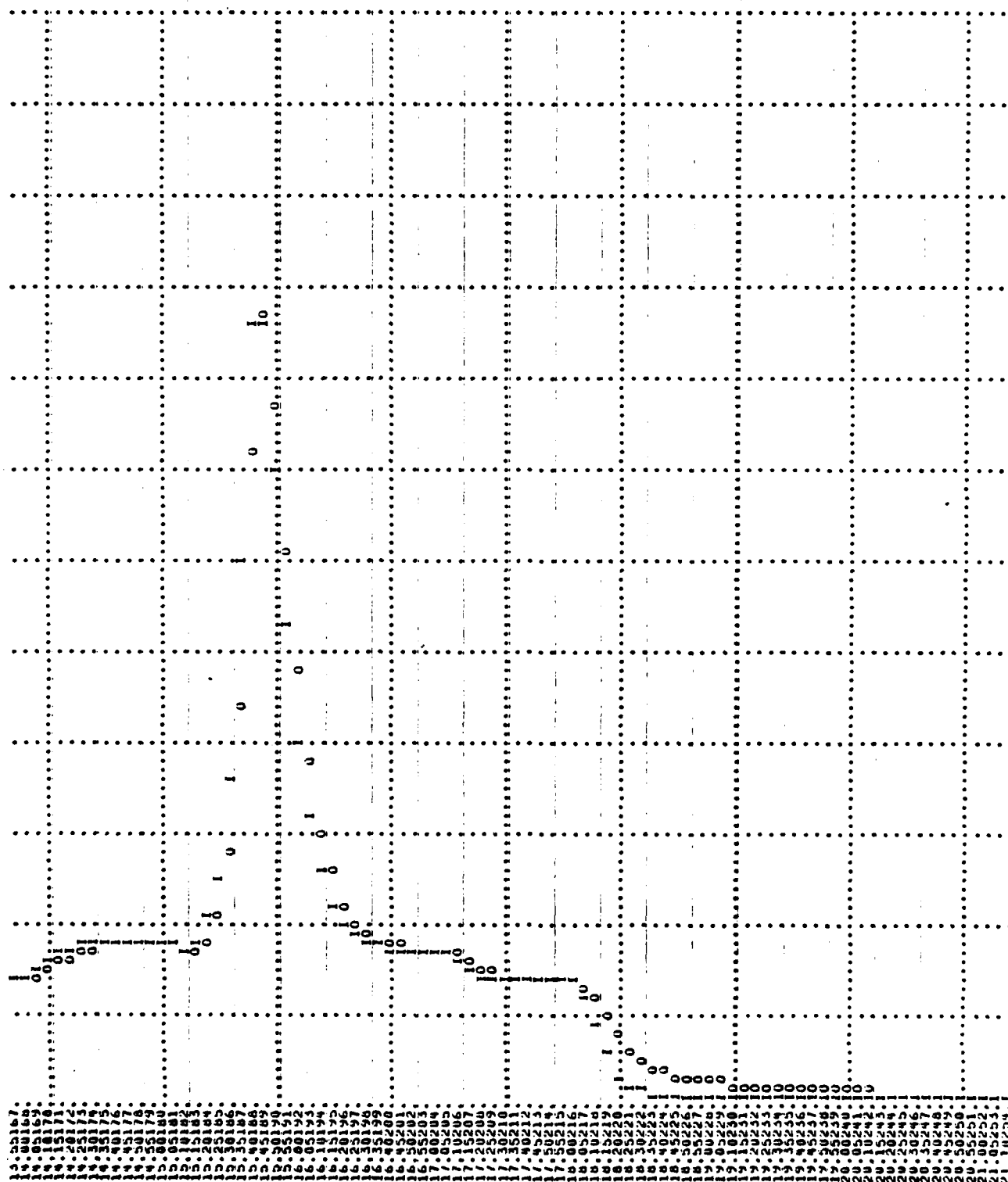
മമ്മമമ്മമമ്മമമ്മ - ഗവൺമെന്റ്

[illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL
CRS	871.	138.	58.	58.	16871.
CRS	25.	6.	2.	2.	472.
INCHES		26.37	30.18	30.76	30.76
MM		669.67	761.11	781.11	781.11
ACFT		38.	113.	113.	113.
THOUS CU M		121.	142.	142.	142.







PEAK FLOW AND STORAGE (LNO OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS -
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

STATION	AREA	PLAN	RATIO 1 .05	RATIO 2 .10	RATIOS APPLIED TO PLUMBS			RATIO 4 .20	RATIO 5 .25	RATIO 6 .30	RATIO 7 .35	RATIO 8 .50	RATIO 9 1.00
OPERATION					RATIO 3 .15								
HYDROGRAPH AT	.07	1	.45	.665	.120	1/3	4.90	.216	.229	.307	.432	.863	
	.10		1.22	2.45	3.67			6.12	7.35	8.57	12.25	24.48	
ROUTED TO	.07	1	.24	.35	.44	1.58	3.92	.187	.290	.378	.419	.871	
	.10			.99	2.37			5.29	6.51	7.70	11.25	24.67	

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
		STORAGE		486.80		486.80		489.00	
		OUTFLOW		13.		13.		32.	
RATIO	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	DURATION	TIME OF	TIME OF	TIME OF
OF	RESERVOIR	STORAGE	DEPTH	OUTFLOW	OUTFLOW	OVER TOP	MAX	MAX	FAILURE
PRE	U.S. LEV	AC-FT	OVER DAM	CF5	CF5	HOURS	HOURS	HOURS	HOURS
0.50	486.24	12.	0.00	0.	0.	0.00	17.00	0.00	0.00
0.75	486.04	22.	0.04	25.	25.	0.00	16.00	0.00	0.00
1.00	485.72	22.	0.13	136.	136.	0.00	15.00	0.00	0.00
1.25	485.63	22.	0.23	136.	136.	0.00	15.00	0.00	0.00
1.50	485.75	22.	0.75	270.	270.	0.00	15.00	0.00	0.00
1.75	485.97	22.	0.97	270.	270.	0.00	15.00	0.00	0.00
2.00	486.19	22.	1.19	270.	270.	0.00	15.00	0.00	0.00
1.00	486.19	22.	1.19	270.	270.	0.00	15.00	0.00	0.00